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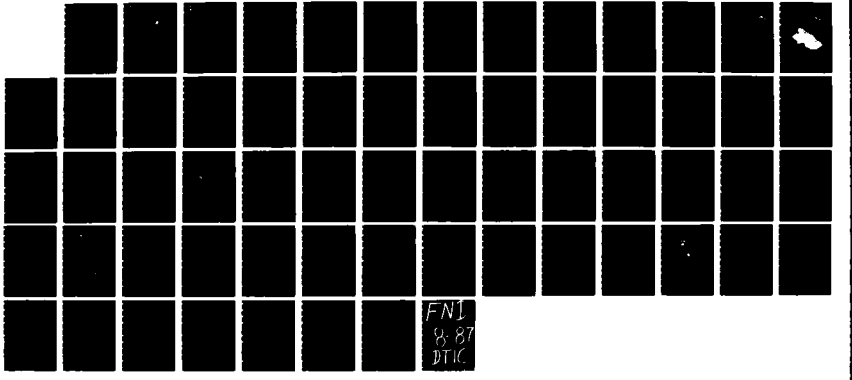

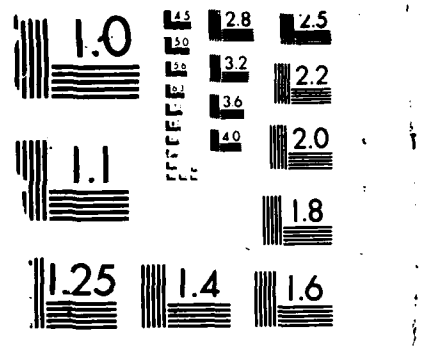

US Army Corps
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St. Paul District

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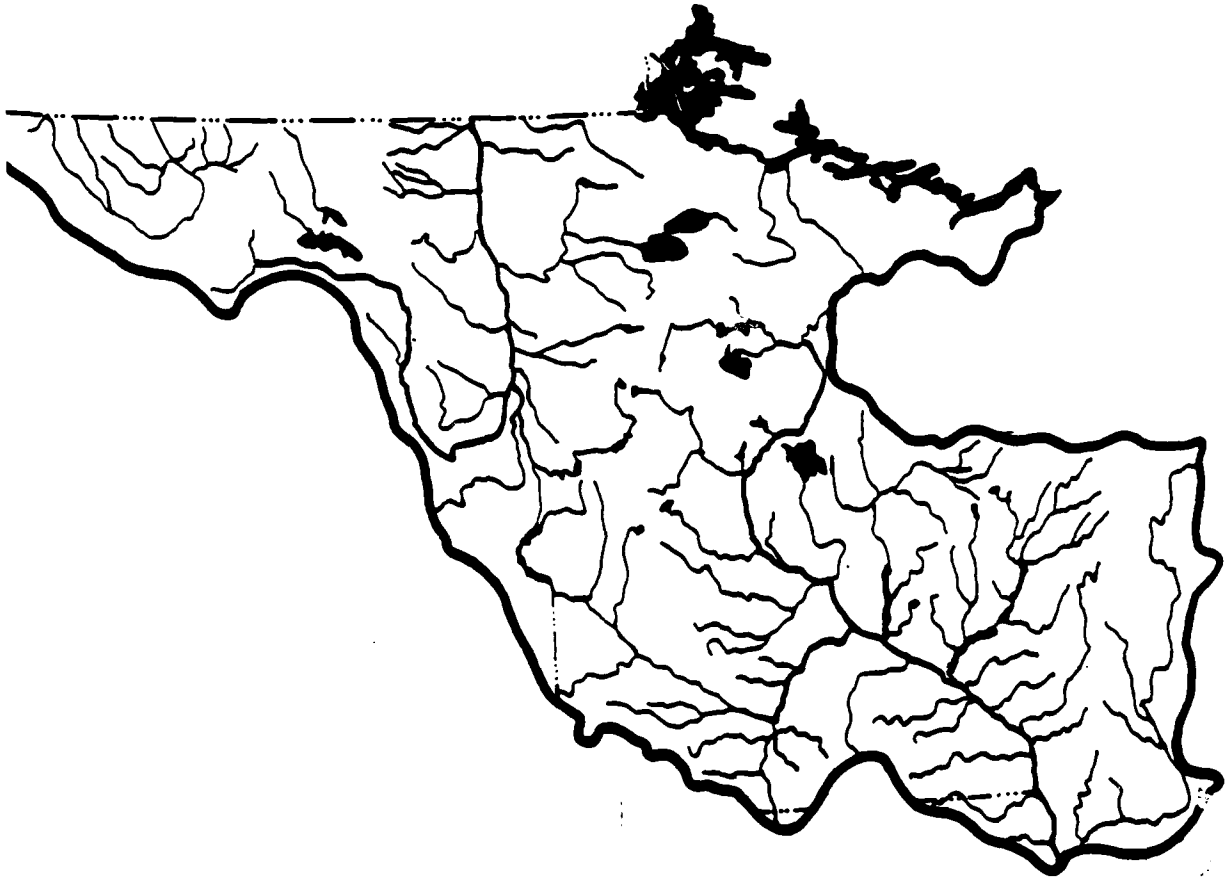

WATER RESOURCE STRATEGIES FOR THE UPPER MISSISSIPPI AND RED RIVER OF THE NORTH BASINS

MARCH 1987

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
1135 U.S. POST OFFICE & CUSTOM HOUSE
ST. PAUL, MINNESOTA 55101-1479

REPLY TO
ATTENTION OF
Plan Formulation
Planning Division

WATER RESOURCE STRATEGIES FOR THE UPPER MISSISSIPPI AND RED RIVER OF THE NORTH BASINS

FOREWORD

Successful water resource planning requires input from all levels of water management and a view toward the future. Planning and development of water projects must be conducted not for extant conditions but for the probabilistic conditions of the future.

This report discusses the adaptive water control strategies in the St. Paul District, basin by basin, under changing climatic conditions. It is intended to stimulate comments from State, regional, and local water managers.

The report is not a recommendation for implementation of projects but a menu of strategies that would be responsive to public needs occasioned by climatic conditions and the resultant social and economic impacts.

Joseph Briggs
Colonel, Corps of Engineers
District Engineer

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This report discusses adaptive water control strategies in the St. Paul District, basin by basin, under changing climatic conditions. It is intended to stimulate comments from state, regional and local water managers.

The report is not a recommendation for implementation of projects but a menu of strategies that would be responsive to public needs occasioned by climatic conditions and the resultant social and economic impacts.

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WATER RESOURCE STRATEGIES FOR THE UPPER MISSISSIPPI AND RED RIVER OF THE NORTH BASINS

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WATER RESOURCE STRATEGIES FOR THE UPPER MISSISSIPPI AND RED RIVER OF THE NORTH BASINS

ST. PAUL DISTRICT

SUMMARY

The primary mission thrusts of the St. Paul District during the next several years will include the following:

- o Operate, maintain, and improve the Mississippi River 9-foot navigation channel including renabilitation of the major control structures.
- o Improve the level of permanent flood protection in the District and initiate feasible new starts for projects acceptable to the public.
- o Maintain floodfignting readiness and competence.
- o Execute the Regulatory Reform Program to protect the waters of the United States.
- o Prepare and execute a strategy to meet changing future needs including automation, modernization, and hydroclimatological change.

Of major importance to our continuing effort will be the future climatic conditions and the resultant impacts on water resources programs and the regional economy. Public perception of need changes with changing water levels.

The Corps of Engineers has had much experience in responding to the short-term climatic variations: events such as floods, droughts, and hurricanes. The long-term hydrologic and, hence, social and economic response to changed climatic conditions has been recognized. Significant changes in climate are occurring as a result of a combination of natural and man-induced mechanisms.

Because of the importance and pervasiveness of any climatic change, we must begin thinking now about probable futures. From a water resource management perspective, this is imperative. Experience has shown that the planning, design, and construction of water developments can take several decades. This means that new major water projects being planned today probably will not be implemented until the 21st century. The design and operation of these future water projects must not be based on the explicit assumption of unchanging climate or unchanging public perceptions of need.

Climate within the St. Paul District has varied considerably since this office was established in 1866. The late 1800's were periods of relatively high waters. During the early to mid 1900's, the area saw a long, persistent drought. Beginning about 1940 to present, we have experienced cooler, wetter climate and a return to high water conditions (see figure on

page 4). Based on our current understanding of the mechanisms causing change, we expect a continuation of relatively high base water conditions in the region over the near term (10 to 20 years) if for no other reason than persistence. In the longer term (20 to 50 years), human interference factors (e.g., "the hothouse effect") may cause a return to low water and drought conditions similar to those experienced in the mid 1930's.

With proper planning and consideration, the conceptual projects of today will, when constructed, maximize the contribution to the economic and social infrastructure of tomorrow even under changing conditions.

The identified potential future conditions and impacts must first be accepted by water resource managers and the public if a corresponding reaction and adjustment in water management is to occur and be implemented in a timely and logical manner.

Water resource managers must guide the public in adopting a phased implementation strategy -- one that systematically addresses the problem by revealing rational priorities for action through time. To be effective, the strategy must be an integral part of a regional effort involving Federal, State, and local interests.

The components of such a program should be supported by an analysis based on the unique supply and demand conditions in the basin in which the environmental, social, economic, institutional, and legal implications are evaluated and the constraints to implementation identified. The strategies contained in this document outline some of the unique basin factors.

The near-term priorities for the St. Paul District are as follows:

Commercial Navigation

Mississippi River Lock Rehabilitation

Flood Damage Prevention: Projects/Studies

1. Lake Darling/Souris River
2. Bassett Creek
3. Rochester
4. State Road Coulee
5. Sheyenne
6. Chaska
7. Marshall
8. Roseau (Reformulated)
9. Houston
10. Portage
11. St. Paul
12. La Crosse
13. Wild Rice River

Flood Damage Prevention: Small Projects

1. Farm Community Protection

    a. Red River of the North
    b. Minnesota River Subbasin

2. Lake Stabilization Projects

    a. Central Minnesota
    b. Northwestern Wisconsin

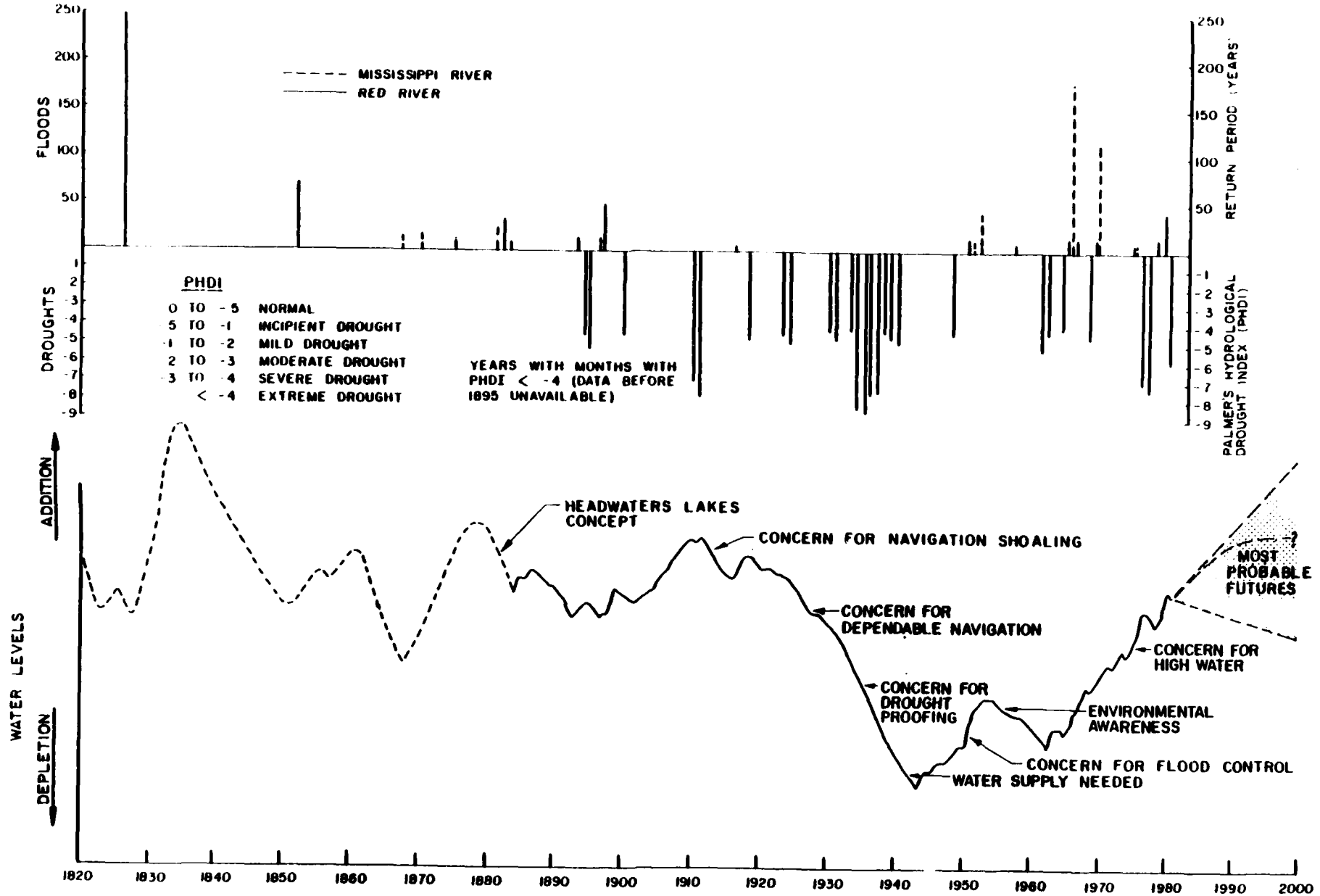
3. Farmstead Protection in the Red River of the North Basin

Other

1. Resource Data Center in the Red River of the North Basin
2. Dam Safety Program throughout District
3. Upper Mississippi River System Environmental Management Program (EMP)
4. Emergency Water Supply Studies

The St. Paul District has international jurisdiction over waters shared with Canada through membership on various International Joint Commission engineering boards and boards of control. We will continue to support water resource solutions to joint United States and Canadian problems. There are opportunities for projects of mutual benefit on both sides of the international boundary in the Souris, Red, and Rainy River basins. Priority projects to be pursued are: Rafferty/Moose Mountain flood control, Emerson/Noyes flood control, and rehabilitation of Rainy River control structures.

In the longer term (15 to 50 years), considerations for a dry scenario must take place. These include operational policy for existing reservoirs, water conservation measures, and water supply measures.



WATER LEVELS AND SOCIAL RESPONSE VS TIME (GENERALIZED)

UPPER MISSISSIPPI RIVER AND RED RIVER OF THE NORTH

MINNESOTA RIVER BASIN, AND CANNON-ZUMBRO-ROOT RIVERS BASIN

1. Description

The Minnesota River basin covers a 16,770-square-mile area which includes all or parts of 37 counties in Minnesota, six in South Dakota, and three in Iowa. The Little Minnesota River (headwaters of the Minnesota River) drains the eastern slope of the Dakota foothills in South Dakota, approximately 30 miles west of the Minnesota border, and flows southeasterly to Big Stone Lake. The Minnesota River flows southeasterly from Big Stone Lake to Mankato where it turns and flows northeast to its confluence with the Mississippi River at Minneapolis-St. Paul. Above Mankato, the tributaries from the southwest are similar in character. Each has a well-developed drainage pattern and each descends rapidly from much higher ground. Thus, they can produce sudden high and devastating flood flows that are frequently greater than flow in the Minnesota River main stem. The tributaries from the north also contribute large volumes of water, but not so suddenly. Runoff from spring snowmelt has caused major flooding in the subbasin during recent years, and the potential exists for even more severe flooding from either snowmelt or summer storms.

The Minnesota River main stem meanders in a valley ranging from 3/4 mile to 1 mile in width and 100 to 200 feet in depth, which was formed in the post-glacial era when it served as an outlet for glacial Lake Agassiz. The river, together with the gentle undulating topography of the basin, provides some of the most productive farmland in Minnesota. The lower portion of the basin contains three major environmental areas: the Minnesota Valley Fish and Wildlife Refuge, managed by the U.S. Fish and Wildlife Service; the Minnesota Valley Trail, operated by the Minnesota Department of Natural Resources; and Fort Snelling State Park, at the confluence of the Minnesota and Mississippi Rivers, which is the most heavily used facility in the State's park system.

The major problems and needs in the basin include existing and future water supply and water quality problems, reduction of urban and rural flood damage, resolution of conflicts between industrial development and preservation interests, increased recreational opportunities, lake eutrophication, and preservation of wild, unique scenic and recreational areas. Due to current "wet" climatic conditions, groundwater tables throughout the basin have been rising which, in turn, leads to increased base flows in streams. Erosion and sedimentation problems are occurring as a result.

Migration into the basin area continued during the decade from 1970 to 1980. The depressed economy and rising costs in farm production influenced migration from farms to urban centers. In 1980, the basin population was 489,832, of which 39 percent were urban, 40 percent were rural nonfarm and 21 percent were farm residents. Per capita income in the basin in 1979 was $6,744.

Agriculture has dominated the industrial output of the basin since early settlement in the latter half of the 19th century. About 76 percent of the total acreage is cropland. The predominant type of farm is cash grain, producing corn and soybeans. Livestock farming and specialized crop farming also make significant contributions to the basin's economy. Increased production efficiency could be obtained on several million acres of crop and pasture land through additional flood prevention, improved drainage, and irrigation.

A commercial navigation channel is authorized for the lower 25.6 miles of the Minnesota River. A 9-foot channel is maintained from river mile 0 to river mile 14.7, and several grain shipping terminals are located in this area. Shipments from these ports accounted for over half of the 5.5 million tons of agricultural products (grain) shipped from the Twin Cities in 1986.

The Minnesota River basin has a continental climate with prevailing winds and storms from the west and southwest, producing comparatively mild, dry weather in all seasons. Occasional periods of high temperatures occur during summer when warm air pushes northward from the Gulf of Mexico.

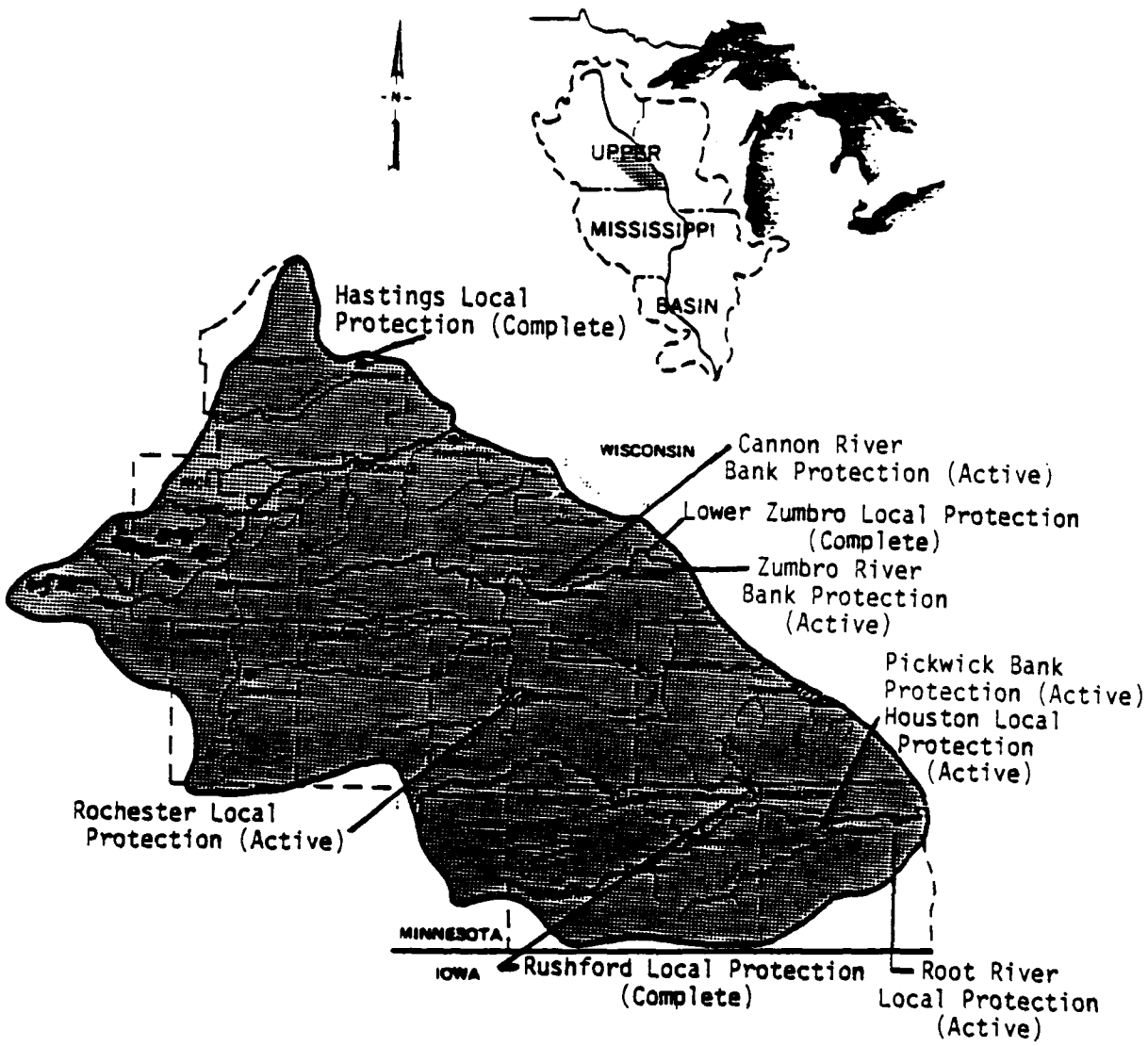
The mean temperatures for the basin are 74°F during July and 13°F in January. The freeze-free growing season generally starts about the second week of May and ends during the first week of October. The area near the Iowa-Minnesota border has the longest growing season - approximately 155 days. The northernmost area of the basin in South Dakota has approximately a 130-day freeze-free period.

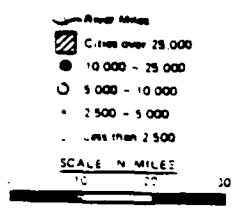
Although total precipitation is important, its distribution during the year is even more significant. Mean annual precipitation ranges from 31 inches at the Iowa-Minnesota border to 20 inches in South Dakota. Approximately two-thirds of the annual precipitation occurs during the cropping season. Seasonal snowfall averages 32 inches in South Dakota to 48 inches in the Iowa portion of the basin, and accounts for 30 percent of total precipitation.

The 1933-34 drought produced record low flows of 26 cfs on the Minnesota River at Mankato during January 1934. The flood of April 1965 produced record high flows of 94,100 cfs at Mankato.

The Cannon, Zumbro, and Root Rivers each share about one-third of a 4,509-square-mile combined drainage area in southeastern Minnesota. The Root River and the lower portions of the Zumbro and Cannon Rivers flow easterly through scenic, unglaciated, deeply-incised valleys and picturesque gorges to the Mississippi River. Conversely, upland areas are characterized by gently rolling agricultural lands with wide shallow valleys. Major cities in the basin include Rochester, home of the Mayo Clinic, and Owatonna, both of which serve as trade centers for southeastern Minnesota.

MINNESOTA RIVER BASIN





CANNON, ZUMBRO, & ROOT RIVERS BASIN

Almost 100,000 persons migrated into the basin between 1970 and 1980. The 1980 population was 324,747 with a farm population over 47,544, rural nonfarm over 123,083, and more than 154,120 urban residents. Migration reflected growth in the basin and a conversion from farm to rural nonfarm residents. Per capita income in 1980 was $7,315.

Current public perception of water and related land resource needs of the basin include flood damage reduction, water quality control, recreation, and fish and wildlife enhancement. Flooding is currently the most serious water resource problem as it has occurred almost every year at some point in the basin.

Rochester suffered an estimated $59 million in damages during the catastrophic flood of July 1978. Water quality problems can occur on each of the rivers as they pass urban areas during low flow periods. Such problems would have an adverse effect on the already limited fishing in the Cannon and Zumbro watersheds. The need also exists to protect an important trout fishery in the Root River watershed. If the climate should return to the hot, dry conditions found during the 1930's, water resource issues would focus on water supply/water quality needs and problems as opposed to the current empnasis on flood damage.

2. **Status of Corps Work**

The Lac qui Parle flood control reservoir on the Minnesota River near Montevideo, Minnesota, was substantially completed by the Works Progress Administration. The project was transferred from the State of Minnesota to the United States in 1950. The Corps of Engineers has completed several improvements which resulted in conservation and recreation benefits in addition to the primary flood control benefits.

The Corps constructed a local protection flood control project to reduce residential and commercial flood damages in the village of Minneota, Minnesota, on the Yellow Medicine River. The project was completed in 1963.

In 1969, construction was completed for a local protection flood control project to reduce commercial and residential flood damages on the Redwood River at Marshall, Minnesota.

An emergency streambank erosion protection project was completed in 1986 on the Minnesota River at Le Sueur, Minnesota.

Improvements for wildlife conservation and development, flood control, and recreation by construction of a local protection flood control project on the Big Stone Lake-Whetstone River are nearly complete. Construction was completed in December 1986.

Urban flood damages will be reduced on the Minnesota River at Mankato and North Mankato, Minnesota, by the local protection flood control project currently being constructed. It is scheduled to be completed in 1990.

Commercial navigation projects were completed in 1931 and 1968 for improvements from the mouth of the Minnesota River at St. Paul upstream to Shakopee, Minnesota.

The Corps completed a reconnaissance report for tne Lac qui Parle flood control project in September 1983 under the Dam Safety Assurance Program. The report recommended that project operation continue and that the stability of tne structure be evaluated.

An emergency action plan under the Flood Emergency Program for Lac qui Parle Dam was completed in September 1984.

Twelve communities in the Minnesota River basin drainage area have emergency levees that were constructed with the assistance of the Corps of Engineers as part of Operation Foresight in 1969. The communities are as follows:

Community	County
Blue Earth	Faribault
Carver	Carver
Chaska	Carver
Granite Falls	Yellow Medicine
Henderson	Sibley
Kasota	Le Sueur
Marshall	Lyon
Montevideo	Chippewa
New Ulm	Brown
St. Peter	Nicollet
Springfield	Brown
Windom	Cottonwood

A flood control project to protect the principal commercial and residential areas along the Root River and Rush Creek at Rushford, Minnesota, was completed in 1969. Remedial work was completed in 1974 and 1979.

A local protection flood control project to alleviate rural flood damages on the lower reacn of tne Zumbro River was completed in 1974.

A snagging and clearing project to reduce flooding damages on Plum Creek, Minnesota, was completed in 1983.

Six communities in tne Cannon-Zumbro-Root Rivers drainage area have emergency levees that were constructed with the assistance of the Corps of Engineers in 1969 as part of Operation Foresight. The communities are as follows:

Community	County
Cannon Falls	Goodhue
Elba	Winona
Houston	Houston
Peterson	Fillmore
Preston	Fillmore
Rochester	Olmsted

Construction of a local flood protection project on the Vermillion River at Hastings, Minnesota, was completed in 1978. The project reduces residential and commercial damages.

The aquatic plant control program will provide for control and progressive eradication of nuisance aquatic plant growth of economic significance in lakes and waterways in the State of Minnesota. The Federal Government will work cooperatively with State and local governments to address and solve problems of mutual interest involving nuisance aquatic plant growth. The program is in the early stage of development and has potential for inclusion of many lakes and waterways in the State.

3. **Future Corps Work**

The following locations or communities need Corps assistance in the future. The table lists them by category, priority, and estimated cost.

Project/ Location	Needs	Time Frame	Function and Benefit Category(1)	Relative Priority	Estimated Cost(2) ($ millions)
Functional Area:	Flood Control				
Zumbro River/ Rochester, MN	Construct levee/ channel project.	1987 to 1992	1A	High	67.8
Minnesota River/ Chaska, MN	Design and construct levee/ channel project.	1988 to 1992	1A	High	28.6
Interim Minnesota River - 639/Tributary Subbasins	Flood damage reduction feasibility study.	1986 to 1992	-	Medium	-
Root River/ Houston, MN	Preconstruction engineering and design for flood damage reduction.	1987 to 1988	1A	High	7.1
Minnesota River/ Henderson, MN	Design and construct levee.	1986 to 1988	1A	High	1.5

Project/ Location	Needs	Time Frame	Function and Benefit Category(1)	Relative Priority	Estimated Cost(2) ($ millions)
Functional Area:	Flood Control (Continued)				
Zumbro River, MN	Design and construct erosion control project.	1986 to 1987	1A	Medium	0.5
Root River/ Hokah, MN	Design and construct flood control structure.	1986 to 1988	1A	High	0.5
Cannon River/ Cannon Falls, MN	Design and construct erosion control project.	1986 to 1987	1A	Medium	0.6
Redwood River/ Marshall, MN	Design and construct project.	1986 to 1991	1A	High	4.6
Lac qui Parle River	Design and construct flood control project.	1986 to 1989	1A	Medium	0.5
Blue Earth River	Design and construct flood control project.	1986 to 1988	1A	Medium	0.5
Granite Falls, MN	Study flood and erosion control.	1987	1A	Medium	-
Upper Sioux Reservation, MN	Study flood and erosion control.	1987	1A	High	-
Wabasha, MN	Study flood control.	1988	1A	Medium	-
Pickwick, MN	Study, design, and construct erosion control project.	1986 to 1988	1A	High	0.5
Undetermined	Design and construct small flood and erosion projects under Section 205 and 14, respectively.	1987 to 1990	1A	Medium	-

Project/ Location	Needs	Time Frame	Function and Benefit Category(1)	Relative Priority	Estimated Cost(2) ($ millions)
Functional Area:	Water Supply/Water Quality				
Minnesota River/ Mankato, MN	Urban study of water supply, stormwater, wastewater, and recreation.	Unknown	2B	Low	-
State of Minnesota	Federal (Corps) Emergency Water Inventory and Planning under EO 11490.	1986 to 1990	2C	High	0.2
Functional Area:	Commercial Navigation				
Minnesota River/ Moutn to River Mile 16 (Savage, MN)	Maintain (dredge) existing navigation channel.	Annual needs	3A	Medium	0.5/ year
Functional Area:	Hydropower None				
Functional Area:	Recreation				
Minnesota River/ Pike Island	Design and construct boat harbor.	1986 to 1988	6B	Low	0.3
Undetermined	Aquatic plant control.	1986 - Continuing	6C	Low	0.1/ year
Functional Area:	Other				
Entire Tributary Area	Flood insurance studies.	Annual needs	1C	Medium	0.5/ year
Entire Tributary Area	Planning assistance studies (Section 22).	Annual needs	1C	Medium	0.5/ year
Marsh Lake Dam Chippewa River Diversion	Flood Emergency Program, Emergency action plans.	Sep 88 Sep 88	N/A N/A	Medium Medium	0.03 0.03

Project/ Location	Needs	Time Frame	Function and Benefit Category(1)	Relative Priority	Estimated Cost(2) ($ millions)
Functional Area:	Other (Continued)				
Marsh Lake Dam Chippewa River Diversion	Dam Safety Assurance Program, Reconnaissance Report.	Sep 87	N/A	Medium	0.8
		Sep 87	N/A	Medium	0.8
Highway 75 Dam Big Stone Lake-Whetstone River	Dam Safety Assurance Program, Reconnaissance Report.	Sep 87	N/A	Medium	0.02
		Sep 87	N/A	Medium	0.02
Highway 75 Dam Big Stone Lake-Whetstone River	Reservoir Operating Plan Evaluation (ROPE)	Oct 86	N/A	Medium	0.05
Lac qui Parle Dam/Minnesota River	Reservoir Operating Plan Evaluation (ROPE)	Oct 86	N/A	Medium	0.05

(1) Function is categorized as:

1. Flood Damage Reduction
2. Municipal - Industrial Water Supply
3. Commercial Navigation
4. Hydropower
5. Beach Erosion Control
6. Recreation

Benefits are categorized as:

A. Benefit-cost ratio (BCR) expected to be greater than 1.0 at the current interest rate, considering benefits only from categories 1-4.
B. BCR expected to be greater than 1.0 at the current interest rate, as long as some benefits are from categories 1-4.
C. All other studies and projects.

(2) Costs were estimated using October 1986 price levels. They include Federal and non-Federal construction costs and are approximate.

4. Summary

The Corps of Engineers water resources planning and development efforts in the Cannon-Zumbro-Root and Minnesota River subbasins will continue to focus on reducing flood and erosion damages, providing floodplain management assistance, and providing technical planning assistance. Implementation of the flood control plan at Rochester, Minnesota, will remove the threat of costly flood damages and make the resources of the nationally known Mayo Clinic more consistently available. It is anticipated that continuing authorities will be used to provide feasible flood reduction solutions to most problems. The interim investigation of the five tributary subbasins of the Minnesota River (639 study) may recommend increased use of continuing authorities projects, i.e. Section 205, Section 208, etc, to reduce flood problems. In the future, the Corps may be asked to address the water quality/water supply problems in these basins. The additional construction authorized for the Redwood River at Marshall, Minnesota, is scheduled for 1989 to 1991 subject to appropriation and allocation of funds.

CHIPPEWA-BLACK AND WISCONSIN RIVER BASINS

1. Description

The Chippewa and Black River basins and the direct drainage to the Mississippi River from mile 713 to mile 779 between Trempealeau and Pepin Counties, Wisconsin, totals an area of about 13,130 square miles, not including the Mississippi River and its floodplain. This area is 7 percent of the Upper Mississippi River basin.

The Chippewa River has as its origin a large number of lakes and swamps in the north central part of Wisconsin. It flows southwesterly to its confluence with the Mississippi River about 75 miles below St. Paul, Minnesota, where it deposits a large amount of sediment into the Mississippi River navigation channel, much of which requires dredging. The total length of the river basin is about 200 miles, the overall difference in elevation is about 650 feet, and it drains 9,480 square miles.

The Black River rises at Black Lakes in west-central Wisconsin and flows for about 183 miles in a southwest direction. It joins the Mississippi River a few miles above La Crosse, Wisconsin. The basin is relatively narrow.

Population of the area was 493,000 in 1980, of which over 65 percent was farm population. The population by the year 2020 is estimated at 635,000. The projections show that farm population will decrease to 8 percent of the total by 2020. This trend toward more urbanization is expected to continue in and around the Eau Claire-Chippewa Falls area. The per capita income was $5,500 in 1979.

The Wisconsin River basin and the direct drainage to the Mississippi River from mile 630 to mile 713, between Crawford County and La Crosse County, Wisconsin, totals an area of 12,816 square miles, not including the Mississippi River and its floodplain. This area is 6.8 percent of the Upper Mississippi River basin.

The Wisconsin River begins in a network of interconnecting lakes and swamps in the northern highland section of Wisconsin. From its source in Lac Vieux Desert, the river flows generally south to Portage, then southwest to its confluence with the Mississippi River a short distance south of Prairie du Chien. The river is about 430 miles long; the overall difference in elevation from source to mouth is 1,050 feet.

In 1907, the State of Wisconsin granted a charter to the Wisconsin Valley Improvement Company to control flows for dependable power and to relieve flood and drought conditions. The company, which is owned by six paper mills and four utilities, owns and operates 20 headwaters reservoirs and 26 hydropower dams.

Population in the Wisconsin River subbasin was 624,000 in 1980, of which about 10 percent was farm population. The population by the year 2020 is estimated at 1,013,000. The projections show that farm population will decrease to 5 percent of the total by 2020. This trend toward more urbanization is expected to continue in and around the major urban areas. The per capita income was $6,200 in 1979.

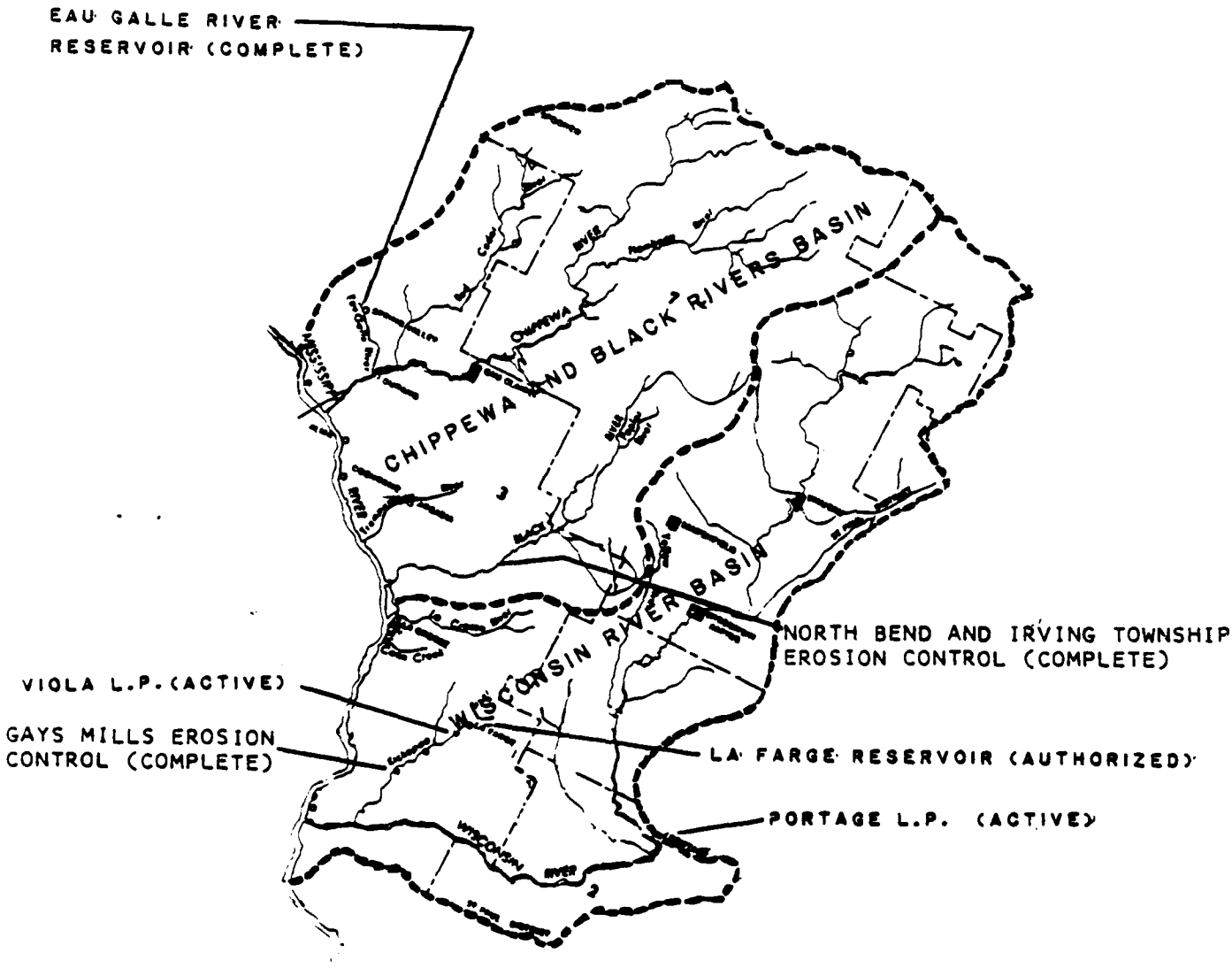
The region has been experiencing increased base streamflow and groundwater levels. The problem has manifested itself at Arcadia, Wisconsin, where groundwater levels are causing foundations to buckle, sewer pipes to break, and city streets to require constant repair. This type of flooding problem was determined as being in the Federal interest by Section 403 of the 1986 Water Resources Development Act.

The economy of the area is primarily based on agriculture and agriculture service areas. In recent years there has been a move to bolster the economy through expansion of the community college system and development of a tourist industry based on river recreation. Much of this area is desirable as a recreation area and is well situated to provide a recreation experience unique to the Upper Midwest.

2. Status of Corps Work

Aside from projects along the Mississippi River main stem, the Corps of Engineers has very few completed projects in this area of Wisconsin. A Corps dam and reservoir, and channel improvements are located just above Spring Valley, Wisconsin, on the Eau Galle River. A drainage ditch was constructed at Cochrane. Near Durand on the Chippewa River is a Section 32 erosion demonstration project at which innovative streambank protection measures have been constructed along about 1 bank mile. Three Section 14 emergency bank protection projects, at North Bend, Irving Township, and Gays Mills, are complete. No local protection projects have been constructed.

The 1962 Flood Control Act authorized the construction of a multi-purpose reservoir with a dam located 1.5 miles north of La Farge on the Kickapoo River. Construction was initiated in 1971, but was suspended in 1975 due to alleged water quality problems and lack of State and Congressional support. Studies in 1976 and subsequent hearings resulted in an Administration recommendation that the study be deauthorized. Congressionally directed investigations in 1983 found a dry dam infeasible and recommended no further study of the dam. Local flood control improvements at Soldiers Grove and Gays Mills were included in the La Farge Dam authorization. Most flood prone structures at Soldiers Grove have been relocated by use of other Federal programs. Initial appraisal studies for Gays Mills and for Viola reveal flood control improvements may be economically feasible. Future detailed studies are needed for local flood protection at Gays Mills and at Viola, which would remain flood prone if La Farge Dam is not completed. Gays Mills was authorized by the 1986 Water Resources Development Act to proceed under the Section 205 program separate from the La Farge authorization.



LEGEND

- BASIN BOUNDARIES
- L.P. LOCAL PROTECTION

LONG RANGE WATER RESOURCES
NEEDS AND PRIORITIES

CHIPPEWA-BLACK, AND WISCONSIN BASINS

A local protection flood control project at State Road and Ebner Coulees was authorized by the 1968 Flood Control Act. The project provides for channel improvement and levees at an estimated $26.3 million Federal and $8.8 million non-Federal cost (October 1986 prices). Planning and engineering for the project are scheduled for completion in 1987; construction completion is scheduled for 1991, if funded for construction in FY 1988 as currently shown in the President's FY 1988 budget request.

A local protection flood control project at Portage was authorized by the Water Resources Development Act of 1986. The plan includes flood control levees for the city at a cost of $6,480,000 (October 1986 prices).

A congressionally authorized feasibility study has been completed for Eau Claire along the Chippewa River. The local protection levee project at Eau Claire, proposed by the Corps in 1975, was rejected by the local sponsor. No further investigation of the project is planned.

A reconnaissance report for Spring Valley Dam was completed in July 1980 under the Dam Safety Assurance Program. It recommends that approximately 60 acres of real estate downstream of the spillway be purchased, the embankment be raised 3.5 feet to obtain the necessary freeboard, and a flood warning system for the recreation area be installed.

An emergency action plan under the Flood Emergency Program was completed for Spring Valley Dam in September 1983. This action plan includes emergency notification procedures, a list of conditions leading to emergencies and ways of dealing with them, and dam failure inundation maps.

The Corps is presently involved in several flood insurance studies in the State under the floodplain management program. Water supply and water conservation and value of wetlands studies are being done under the Section 22 program. In addition, several small project studies are being conducted under the Corps continuing authorities program.

3. Future Corps Work

The following locations or communities need Corps assistance in the future. The table lists them by category, priority, and estimated cost.

Project/ Location	Needs	Time Frame	Function and Benefit Category(1)	Relative Priority	Estimated Cost(2) ($ millions)
Functional Area:	Flood Control				
La Crosse, WI	Design and construct channel modification/levee project at State Road Coulee.	1989 to 1994	1A	High	35.1

Project/ Location	Needs	Time Frame	Function and Benefit Category(1)	Relative Priority	Estimated Cost(2) ($ millions)
Functional Area:	Flood Control (Continued)				
Gays Mills, WI	Design and construct local flood control levee under Section 205	1987 to 1990	1A	High	2.0
Viola, WI	Design and construct local flood control relocation project under Section 205.	1986 to 1990	1A	High	0.9
Portage, WI	Design and construct local flood control levees project.	1989 to 1994	1A	High	6.5
Boscobel, WI	Design and construct local flood control channel project.	1987 to 1990	1A	High	0.7
Arcadia, WI	Design and construct local flood control levee.	1986 to 1990	1A	High	5.0
Undetermined	Design and construct small flood and erosion control projects under Section 14.	1986 to 1990	1A	High	-
Functional Area:	Water Supply/Water Quality				
State of Wisconsin	Federal (Corps) Emergency Water Inventory and Planning under EO 11490	1986 to 1990	2C	High	0.2
Functional Area:	Commercial Navigation None				
Functional Area:	Hydropower None				
Functional Area:	Recreation/Beach Erosion		None		

Project/ Location	Needs	Time Frame	Function and Benefit Category(1)	Relative Priority	Estimated Cost(2) ($ millions)
Functional Area: Other					
Spring Valley Dam, Dam Safety	Real estate and flood warning system.	1987 to 1988	1A	Hign	0.6
Undetermined	Flood insurance studies.	1984 to 2000	N/A	High	1.0
Undetermined	Special studies under Section 22.	1984 to 2000	N/A	Hign	2.0

(1) Function is categorized as:

1. Flood Damage Reduction
2. Municipal - Industrial Water Supply
3. Commercial Navigation
4. Hydropower
5. Beach Erosion Control
6. Recreation

Benefits are categorized as:

A. Benefit-cost ratio (BCR) expected to be greater than 1.0 at the current interest rate, considering benefits only from categories 1-4.
B. BCR expected to be greater than 1.0 at the current interest rate, as long as some benefits are from categories 1-4.
C. All other studies and projects.

(2) Costs were estimated using October 1986 price levels. They include Federal and non-Federal construction costs and are approximate.

4. Summary

Corps of Engineers involvement in water resources planning and development within the interior of Wisconsin is increasing. There are significant water resource problems in some areas that need a corrective effort. Strategy in Wisconsin will be to concentrate on finishing the designs and initiating construction on flood protection projects at State Road Coulee, Portage, and along the Kickapoo River, where feasible. In addition, the District will insure that information is available on Corps programs and on the status and impact of non-engineered emergency levees. In regard to the latter, efforts will concentrate on the Small Projects Program to improve emergency levee conditions at some 15 scattered communities.

SOURIS-RED-RAINY REGION

1. Description

The Souris-Red-Rainy region is a roughly triangular-shaped area located along the northern borders of North Dakota and Minnesota. The region extends to Montana in the west and to Lake Superior in the east. The southern tip of the region reaches as far as South Dakota along the North Dakota-Minnesota border. Three river basins - Souris, Red, and Rainy - make up the approximately 60,000-square mile United States portion of the region. The region is unique because the major rivers either form an international boundary water or flow from one country to another. Water from all three basins eventually drains into Lake Winnipeg and into Hudson Bay in Canada.

The topography of the region is diverse. In the east is an area of lakes, ridges, and hills; the center portion includes the very flat Red River Valley; and the western part is a rolling drift prairie dotted with pothole lakes.

Annual precipitation varies from less than 14 inches in the west to 28 inches in the east. Runoff also varies across the region, but generally increases toward the east.

Agriculture is the basic industry; however, the Rainy River basin also depends on timber and tourism for a share of its economic well-being. The importance of this region to domestic (and foreign) food production is well documented. Compared to national agricultural production figures, the Red River basin alone produces 3/4 of the sunflowers, 1/3 of the barley, 1/4 of the sugar beets, 1/5 of the flax, and 1/10 of all the wheat, oats, and potatoes. The annual value of these products is nearly $4 billion.

Population of the region is approximately 727,000 (1980 census), of which 45 and 55 percent live in urban and rural areas, respectively. By the year 2000, the population should be almost 800,000 according to State projections. There are two standard metropolitan statistical areas, the Fargo-Moorhead area and the Grand Forks/East Grand Forks area.

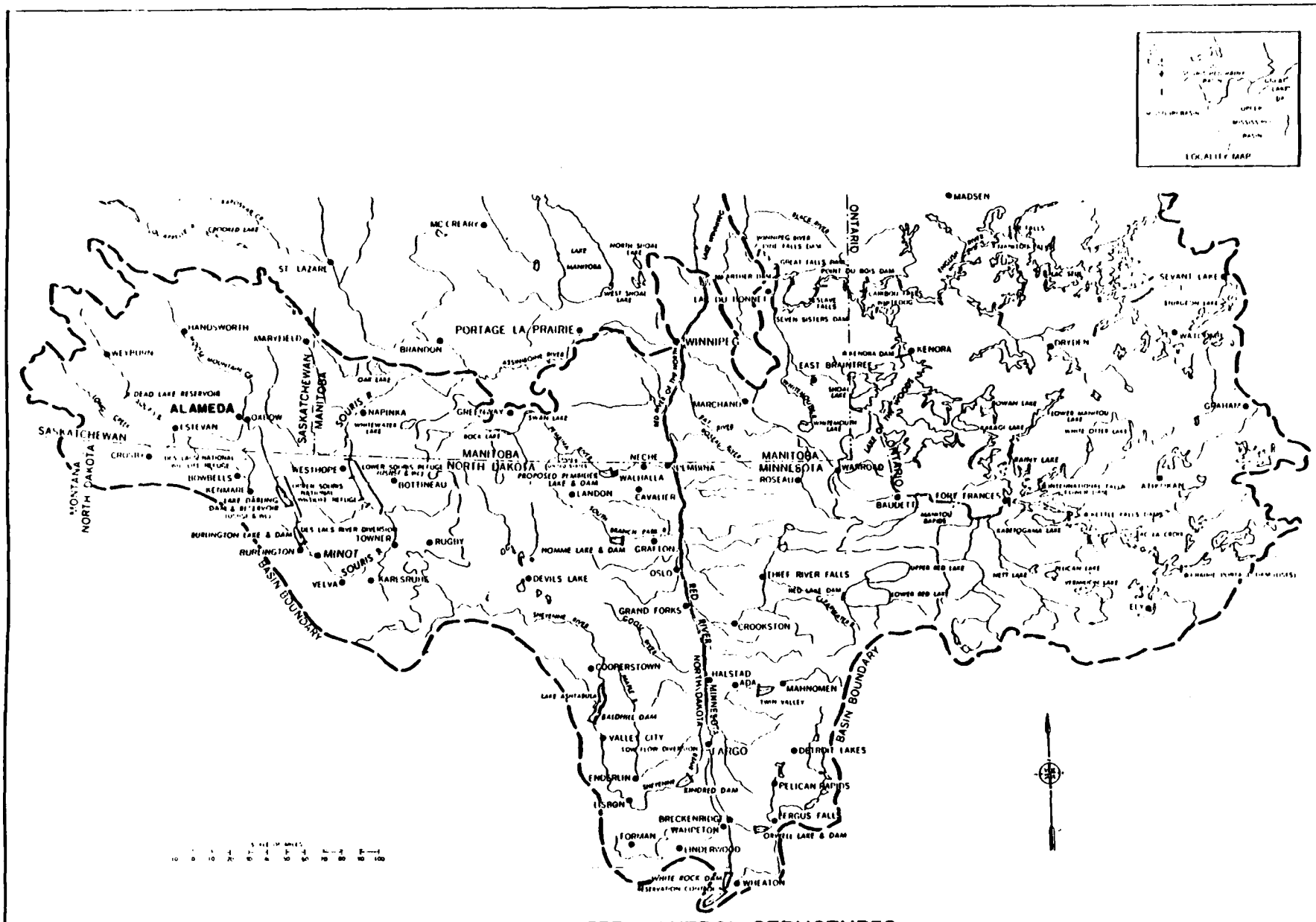
The developmental opportunities of the region are limited by a variety of water resource problems. Flooding is a significant problem which occurs primarily as a result of spring snowmelt, often aggravated by rain. The worst flooding is in the central half of the region. In this area, the water can spread for miles on the flat landscape. Regional average annual flood damage to rural areas is almost twice that of urban areas. In the Red River basin, over 2-1/2 million acres of highly productive farmland and over 50 communities are subject to flooding. In the Souris River basin, the 1969 flood inundated 3,000 homes and required evacuation of about 12,000 persons. Another water resource problem is water supply which is not adequate to meet the needs in the Souris and Red River basins. The 1976 near-drought year brought attention to this problem. To a much lesser

extent, problems in recreation, water quality, erosion control, and fish and wildlife conservation also exist in the region.

Water resource problems of the region are influenced by climatic conditions. Since 1900, both dry (1900-1940) and wet (1940-present) periods have occurred, emphasizing inadequate water supplies and flooding concerns, respectively. At present, rising lake levels (Devils Lake) and increasing stream base flows are significant water resource problems for basin residents. If present climatic conditions prevail in the future, flood damage reduction measures will continue to be the focus of water managers. Conversely, if the "Greenhouse Effect" (warmer/drier) dominates, then water supply/drought control measures will be emphasized. Water managers should concentrate on promoting drought proofing in both urban and rural settings. An adaptive strategy will be formulated and made available for application to future needs.

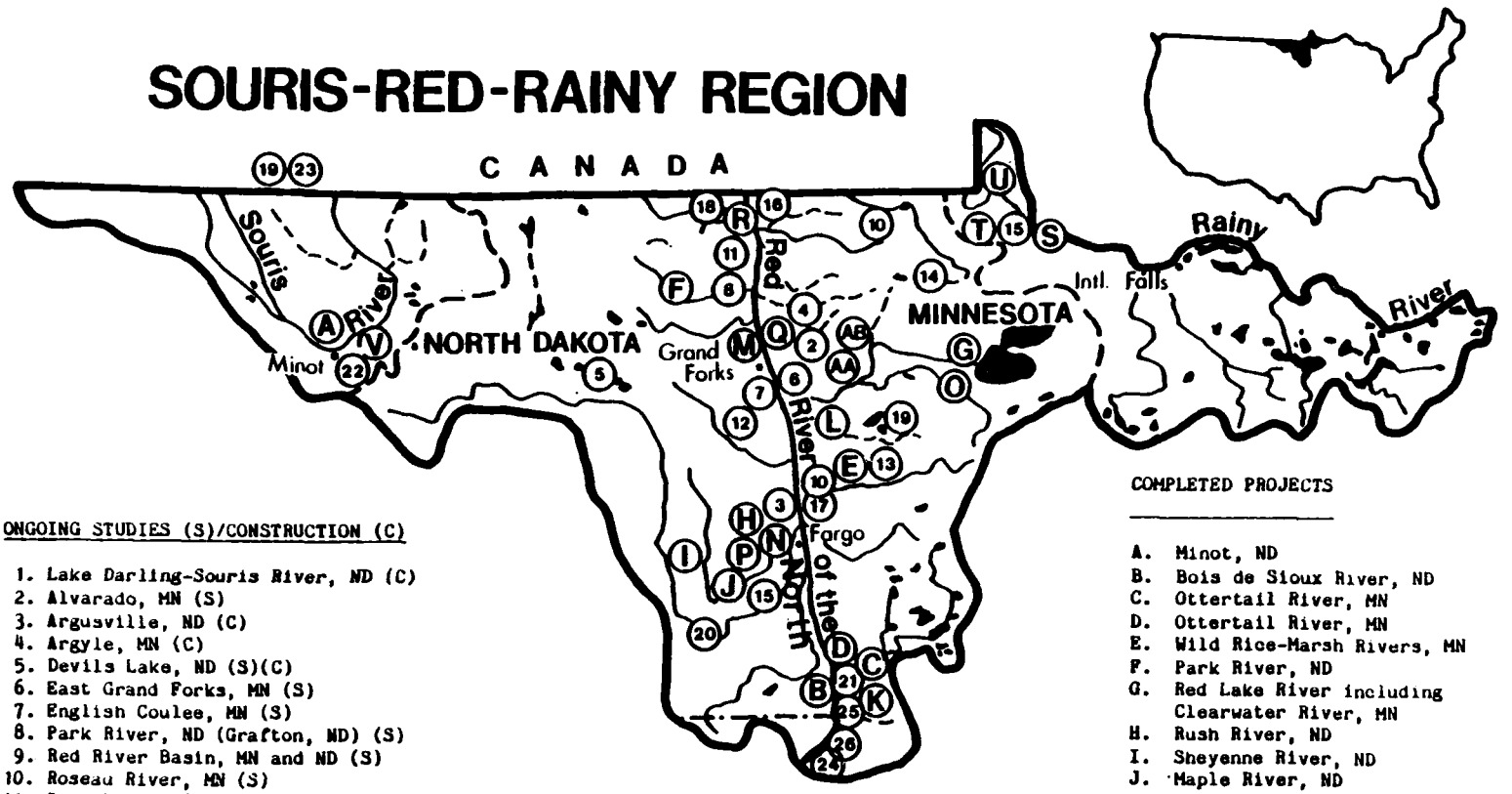
The use of the international boundary waters resource has been coordinated under the Boundary Waters Treaty of 1909. However, a structured basin planning approach for future use needs to be accomplished. There are several areas of potential future benefit to both the United States and Canada to include: hydropower, flood control, fish and wildlife, recreation, and rice production. In order to achieve and maximize these benefits, a plan of study which addresses the near-term and long-term must be developed jointly. Study efforts and potential benefits would be identified and prioritized by critical needs, and by the value of the benefits returned. An overall basin study would be the initial study effort in order to provide a basis for mutual agreement on priorities and future direction, followed by specific studies of features leading to an optimized use of the boundary water resource. Several potential study areas are listed below with estimated study costs.

Type of Study	Estimated Cost ($1,000's)
o Overall basin study to develop comprehensive framework plan	$2,000
o Rehabilitation of water control structures to provide greater flexibility to control floods	1,000
o Increase run-of-river hydropower at existing sites (Fort Frances, International Falls)	1,000
o Hydraulic model of the basin - flow predictive for Kettle Falls and Rainy Lake outlets	200
o Other:	
Stream gage at Gold Portage	5
Precipitation and stream gaging at Maligne River	5



WATER CONTROL STRUCTURES
SOURIS-RED-RAINY RIVER WATERSHEDS

SOURIS-RED-RAINY REGION



ONGOING STUDIES (S)/CONSTRUCTION (C)

1. Lake Darling-Souris River, ND (C)
2. Alvarado, MN (S)
3. Argusville, ND (C)
4. Argyle, MN (C)
5. Devils Lake, ND (S)(C)
6. East Grand Forks, MN (S)
7. English Coulee, MN (S)
8. Park River, ND (Grafton, ND) (S)
9. Red River Basin, MN and ND (S)
10. Roseau River, MN (S)
11. Ring Levees (Farmstead), ND
12. Sheyenne River, ND (S)
13. Wild Rice River, MN (Twin Valley Lake) (S)
14. Red Lake, MN (S)
15. Zippel Bay, MN (C)
16. Noyes, MN (S)
17. Perley, MN (S)
18. Necne, ND (S)
19. Souris River Basin, USA & Canada (S)
20. Valley City, ND (C)
21. Breckenridge, MN (S)
22. Velva, ND (C)
23. Souris River Basin Project, USA & Canada (S)
24. Bois de Sioux River Channel, MN, SD, & ND (S)
25. Orwell ROPE, MN (S)
26. Lake Traverse ROPE, MN and SD (S)

SCALE 1:4,400,000

0 100 200 Miles

COMPLETED PROJECTS

A. Minot, ND
B. Bois de Sioux River, ND
C. Ottertail River, MN
D. Ottertail River, MN
E. Wild Rice-Marsh Rivers, MN
F. Park River, ND
G. Red Lake River including Clearwater River, MN
H. Rush River, ND
I. Sheyenne River, ND
J. Maple River, ND
K. Mustinka River, MN
L. Sand Hill River, MN
M. Grand Forks, ND
N. Fargo, ND
O. Lost River, MN
P. Lower Branch Rush River, ND
Q. Oslo, MN
R. Pembina, ND
S. Baudette, MN
T. Zippel Bay, MN[1/]
U. Warroad, MN
V. Velva Bonnes Coulee Section 14, ND
W. Enderlin, ND
X. Halstad, MN
Y. Mahnomen Section 14, MN
Z. Breckenridge Section 14, MN
AA. Red Lake Falls Section 14, MN
BB. Hout Section 14, MN

1/ Project is no longer in existence.

2. Status Of Corps Work

Past studies and completed projects in this region have focused on the Red River basin. Recent activities have also included the Souris River basin. The Rainy River basin, with much smaller-scale water resource problems, has received only limited attention.

In 1936, planning was initiated by the Corps of Engineers for flood control and related purposes in the Red River basin. To respond to the drought in the 1930's, initial emphasis was on water conservation. Projects constructed from studies undertaken during this period were planned primarily for water supply, with less emphasis on flood control, recreation, and fish and wildlife. These projects included Lake Traverse (Bois de Sioux River, Minnesota), Lake Ashtabula (Sheyenne River, North Dakota), Red Lake and Clearwater Rivers (Red Lake River, Minnesota), and Homme Lake (Park River, North Dakota).

In the early 1940's, widespread flooding changed the emphasis to flood control in the Red River basin. Because the flat topography precluded development of large water storage areas, other flood damage reduction measures (tributary channel improvements and levees) were used to reduce damages at the principal urban damage centers. Seven more projects were constructed from this effort, including Orwell Lake (Ottertail River); channel improvements on the Lower Sheyenne, Maple, and Rush Rivers in North Dakota, and on the Mustinka, Ottertail, Wild Rice, Marsh, and Sand Hill Rivers in Minnesota; and levees at Wahpeton-Breckenridge, Fargo-Moorhead, and Grand Forks-East Grand Forks.

In the Red River, widespread near-record floods occurred during the 1950's, resulting in the ongoing basin study, initiated in 1956. Early studies resulted in construction of local protection levees at Oslo, Minnesota, and Grand Forks and Pembina, North Dakota, and channel improvement projects for the Lower Branch Rush River, North Dakota, and Wild Rice River-South Branch Felton Ditch, Minnesota. More recently, to reduce flood damages, construction was completed at Enderlin, North Dakota, and Halstad, Minnesota. Flood control construction has begun on local protection projects at Argusville and Devils Lake, North Dakota, and Argyle, Minnesota. Urban studies were completed for the Grand Forks-East Grand Forks and Fargo-Moorhead metropolitan areas. Flood control studies were completed for East Grand Forks, Minnesota, and Grafton, Pembina River, and Sheyenne River, North Dakota.

In the Souris River basin, one channel improvement project was completed in 1980 at Minot, North Dakota, and construction is nearing completion on the Velva portion of the Lake Darling project. Also, one emergency streambank protection project was completed in 1984 at Bonnes Coulee and one other is now under construction at the sewage lagoons downstream of Velva. Completed and operating projects in the Rainy River basin include two harbor projects at Baudette and Warroad, Minnesota. Construction of a recreational navigation project is currently underway at Zippel Bay, Minnesota.

Dam Safety Assurance reconnaissance reports have been completed for Baldhill Dam, Orwell Dam, Homme Dam, and White Rock Dam. Of these, Baldhill Dam is the most critical because the embankment does not meet current slope stability requirements and the spillway has inadequate discharge capacity. If the structure were to fail, approximately 75 percent of Valley City would be inundated.

Flood emergency action plans were completed in September 1983 for Baldhill Dam, Orwell Dam, Homme Dam, and White Rock Dam. These action plans include emergency notification procedures, a list of conditions leading to emergencies, ways of dealing with emergencies, and dam failure inundation maps.

The Lake Traverse and Orwell Reservoir projects are currently undergoing reservoir operation plan evaluations (ROPE). The water control plans for the two projects are being reviewed in detail to ensure that the projects are providing maximized benefits under current conditions. The Bois de Sioux River channel is being evaluated under the Lake Traverse ROPE to determine the need for rechannelization.

Coordination with Canada is accomplished through the International Joint Commission, its International Souris-Red Rivers Engineering Board, and three International Boards of Control -- the Souris River, Rainy Lake, and Lake of the Woods. Continued coordination is required during the planning and development of water resource management activities to assure adequate involvement of international interests and resolution of identified concerns.

Emergency actions have prevented over $130 million of damage in the region since 1977. In all, 29 communities, as shown on the following list, have emergency levees that were constructed with the assistance of the Corps of Engineers. The emergency actions were undertaken to respond to flood threats of 1965, 1969, 1978, and 1979.

Minnesota	
City	County
Ada	Norman
Alvarado	Marshall
Crookston	Polk
East Grand Forks	Polk
Hallock	Kittson
Halstad	Norman
Hendrum	Norman
Moorhead	Clay
Noyes	Kittson
Perley	Norman
Roseau	Roseau
St. Vincent	Kittson

North Dakota	
City	County
Enderlin	Ransom
Fargo	Cass
Grand Forks	Grand Forks
Harwood	Cass
Horace	Cass
Lisbon	Ransom
Logan	McHenry
Mapleton	Cass
Minot to Burlington	Ward
Necne	Pemoina
Pembina	Pembina
Riverside	Cass
Sawyer	Ward
Valley City	Barnes
Velva	Ward
Wanpeton	Richland
West Fargo	Cass

Section 14 projects exist at Mannomen (1983), Breckenridge (1981), Huot (1983), and Red Lake Falls (1983), Minnesota. Also, one other Section 14 project is now under construction at Valley City, North Dakota.

The aquatic plant control program is designed to provide control and progressive eradication of nuisance aquatic plant growth of economic significance in lakes and waterways in the States of Minnesota and North Dakota. The Corps of Engineers works cooperatively with State and local governments to address and solve problems of mutual interest involving nuisance aquatic plant growth. The program is in the early stage of development and has potential for inclusion of several lakes and waterways in the two States.

3. Future Corps Work

The following locations or communities need Corps of Engineers assistance in the future. The table shows them by category, priority, and estimated cost for each location.

Project/ Location	Needs	Time Frame	Function and Benefit Category(1)	Relative Priority	Estimated Cost(2) ($ millions)
Functional Area: Flood Control					
Lake Darling, ND - Souris River Basin	Purchase flood storage in Rafferty and Alameda Dams in Saskatchewan. Design and construct flood gates at Lake Darling and downstream measures and operate for U.S. flood control. If agreement cannot be reached with Saskatchewan, work will proceed with construction of the 4-foot raise at Lake Darling.	1987 to 1994	1A	High	87.5
Twin Valley Lake, MN, Wild Rice River - Red River Basin	Construct a 52,200 acre-foot impoundment to reduce agricultural and urban flood damages and to provide for water-based recreation.	1989 to 1993	1A	Medium	29.9

Project/ Location	Needs	Time Frame	Function and Benefit Category(1)	Relative Priority	Estimated Cost(2) ($ millions)
Functional Area:	Flood Control (Continued)				
Roseau River, MN - Roseau River - Red River Basin	Reformulate channel modifications and associated features.	1987 to 1990	1A	Medium	1.5
Argusville, ND - Red River Basin	Construct a levee project.	1987	1A	Hign	1.0
Argyle, MN, Middle River-Red River Basin	Construct a levee project.	1987	1A	High	1.3
Crookston, MN, Red Lake River	Study, design, and construct a levee project.	1990 to 2000	1A	High	15.0
Englisn Coulee, ND - Red River Basin	Design and construct a local protection project.	1987 to 1989	1A	High	0.8
Noyes, MN - Red River Basin	Design and construct a Canadian and U.S. local protection project.	1985 to 1987	1A	High	0.4
Alvarado, MN - Snake River - Red River Basin	Design and construct a levee project.	1987 to 1989	1A	Medium	0.5
E. Grand Forks, MN - Red River Basin	Design and construct a levee project.	1990 to 1995	1A	High	33.7
Grand Forks, ND Red River Basin	Study, design, and construct a flood protection project.	1990 to 2000	1A	High	20.0
Grafton, ND - Park River-Red River Basin	Design and construct a levee and bypass channel project.	1990 to 1995	1A	High	19.2

Project/ Location	Needs	Time Frame	Function and Benefit Category(1)	Relative Priority	Estimated Cost(2) ($ millions)
Functional Area:	Flood Control (Continued)				
Sheyenne River, ND - Red River Basin	Design and construct levees, diversions, and other flood damage reduction measures.	1989 to 1994	1A	High	40.4
Maple River Reservoir, ND	Reconnaissance to determine feasibility.	1989 to 1990	1A	Medium	0.3
Farmstead Levees, ND - Red River Basin	Develop detailed plans, design and construct ring levees for farmsteads in Walsh and Pembina Counties, ND.	1987 to 1988	1A	High	4.0
Red Lake, MN - Red River Basin	Local flood and erosion protection.		1A	Low	-
Wild Rice-Marsh Rivers, Norman County, MN	Study to determine channel project modification and extension.	1987 to 1988	1A	High	0.4
Perley, MN - Red River Basin	Local flood protection.	1988 to 1990	1A	Medium	0.5
Devils Lake, ND - Devils Lake Subbasin - Red River Basin	Study, design, and construct a flood damage reduction project to control the nigh lake levels.	1990 to 2000	1A	High	20.0
Devils Lake, ND	Construct a Section 205 flood control project for tne community.	1987	1A	High	2.0

Project/ Location	Needs	Time Frame	Function and Benefit Category(1)	Relative Priority	Estimated Cost(2) ($ millions)
Functional Area:	Flood Control (Continued)				
Small Flood Control Projects - Regionwide	Study, design, and construct plans of improvement for flood damage reduction in urban and rural areas.	Continuous	1A	Hign	0.5/ year
Necne, ND - Pembina River Basin	Design and construct a local protection project.	1987 to 1990	1A	Medium	0.5
Dam Safety Assurance Program - Red River Basin	Modification of existing Federal dams with potential safety hazards to permit the projects to function effectively and as originally intended.	1987 to 1991	1A	High	45.0
Floodplain Management Services - Regionwide	Provide assistance and guidance in identifying the magnitude and extent of flood hazards in floodplain areas.	Continuous	1C	High	0.3/ year
Planning Assistance to States - Regionwide	Assist States in preparation of comprehensive plans for the development, utilization, and conservation of water resources.	Continuous	1C, 2C	High	0.2/ State/ year
Kawishiwi River - Rainy River Basin	Address problems and needs related to flooding and walleye spawning nabitat.	1990 to 1995	1C	Low	3.0

Project/ Location	Needs	Time Frame	Function and Benefit Category(1)	Relative Priority	Estimated Cost(2) ($ millions)
Functional Area:	Flood Control (Continued)				
Technical Resource Service - Regionwide	Establish and begin operating a service that will assist local and State interests in reducing flood damages and address other needs.	1987 to 1990	1A	High	0.3/ year
Lake Traverse Reservoir Operating Plan Evaluation	Review and update water control plan to maximize project benefits and evaluate need for rechannelization of Bois de Sioux River.	1986 to 1990	1A	High	0.3
Orwell Reservoir Operating Plan Evaluation	Review and update water control plan to maximize project benefits and evaluate need for rechannelization of Bois de Sioux River.	1985 to 1990	1A	High	0.2
Functional Area:	Water Supply/Water Quality				
Red River Basin	Identify drought contingency action to minimize/prevent shortages during the next major water supply problem.	1985 to 1990	2C	High	1.0
State of Minnesota	Federal Emergency Water Inventory and planning under EO 11490.	1985 to 1990	2C	High	0.2
Functional Area:	Commercial Navigation		None		

Project/ Location	Needs	Time Frame	Function and Benefit Category(1)	Relative Priority	Estimated Cost(2) ($ millions)
Functional Area:	Hydropower				
Rainy River Basin	Study, design, and repair/construct Rainy River control structures for hydropower and other purposes (Joint Canadian/ U.S. effort).	After 1987	4A	Low	
Functional Area:	Recreation				
Zippel Bay, MN - Rainy River Basin	Construct a channel to link Zippel Bay to Lake of the Woods and a jetty to protect the channel from waves and to reduce shoaling.	1986 to 1987	6C	Medium	0.8
East Two Rivers, MN - Rainy River Basin	Clear and maintain a channel between the Marina at Tower, MN, and Lake Vermilion.	1990 to 1995	6C	Low	1.0
Souris-Red-Rainy	Control and progressively eradicate nuisance aquatic plant growth in basin lakes and waterways.	Continuous	NA	Low	0.1
Functional Area:	Other				
Section 14 Studies - Souris-Red-Rainy Region	Provides for the development of detailed plans for the construction of bank protection projects that will protect essential public works.	Continuous	1A	High	0.2/ year

Project/ Location	Needs	Time Frame	Function and Benefit Category(1)	Relative Priority	Estimated Cost(2) ($ millions)
Functional Area: Other (Continued)					
Baldhill Dam Dam Safety	Study, design, and repair/construct deficiencies.	1986 to 1992	1B	High	35.6
Orwell Dam Dam Safety	Study, design, and repair/construct deficiencies.	1986 to 1989	1B	High	1.5
Homme Dam Dam Safety	Study, design, and repair/construct deficiencies.	1986 to 1989	2B	High	1.0
Red Lake Dam Safety	Reconnaissance report.	1988	1B	High	0.02
Lake Traverse Dam Safety	Reconnaissance report.	1986 to 1989	1B	High	0.02

(1) Function is categorized as:

1. Flood Damage Reduction
2. Municipal - Industrial Water Supply
3. Commercial Navigation
4. Hydropower
5. Beach Erosion Control
6. Recreation

Benefits are categorized as:

A. Benefit-cost ratio (BCR) expected to be greater than 1.0 at the current interest rate, considering benefits only from categories 1-4.
B. BCR expected to be greater than 1.0 at the current interest rate, as long as some benefits are from categories 1-4.
C. All other studies and projects.

(2) Costs were estimated using October 1986 price levels. They include Federal and non-Federal construction costs and are approximate.

4. Summary

The Souris-Red-Rainy region experiences several water and related land resource problems, the most prominent of which are flooding and drought/water supply. While much has been done to reduce the impact of these problems on the economic and social well-being of the region's inhabitants, much more remains to be done. Working through the traditional Corps of Engineers authorities can help, as demonstrated in the past. New programs such as the Souris River basin study in cooperation with Canada, the farmstead ring levee program, and better coordination of technical assistance through sharing professional skills and information at a local level can meet a comparatively new need in the region. An international basin-wide approach to water resources problems can result in substantial cost savings in flood damage reduction and other water resource purposes for both Canada and the United States. With the advent of the on-farm storage program in the 1970's, millions of dollars worth of grain is now susceptible to flooding. A major summer event such as the 1975 flood would conceivably destroy the equivalent of 20 percent of the spring wheat crop in the United States. Implementing new ideas, such as the Technical Resource Service, would improve the chances that faster resolution of the region's water problems can be accomplished at less cost to the Nation.

In some areas of the region, emphasis should be placed on preservation and recreational resource opportunities with less attention given to flood damage reduction needs. Cooperation, primarily through the International Joint Commission's International Boards of Control of Rainy Lake and Lake of the Woods and the Souris-Red Rivers Engineering Board, will improve water resource management in the region.

UPPER MISSISSIPPI RIVER - MAIN STEM

1. Description

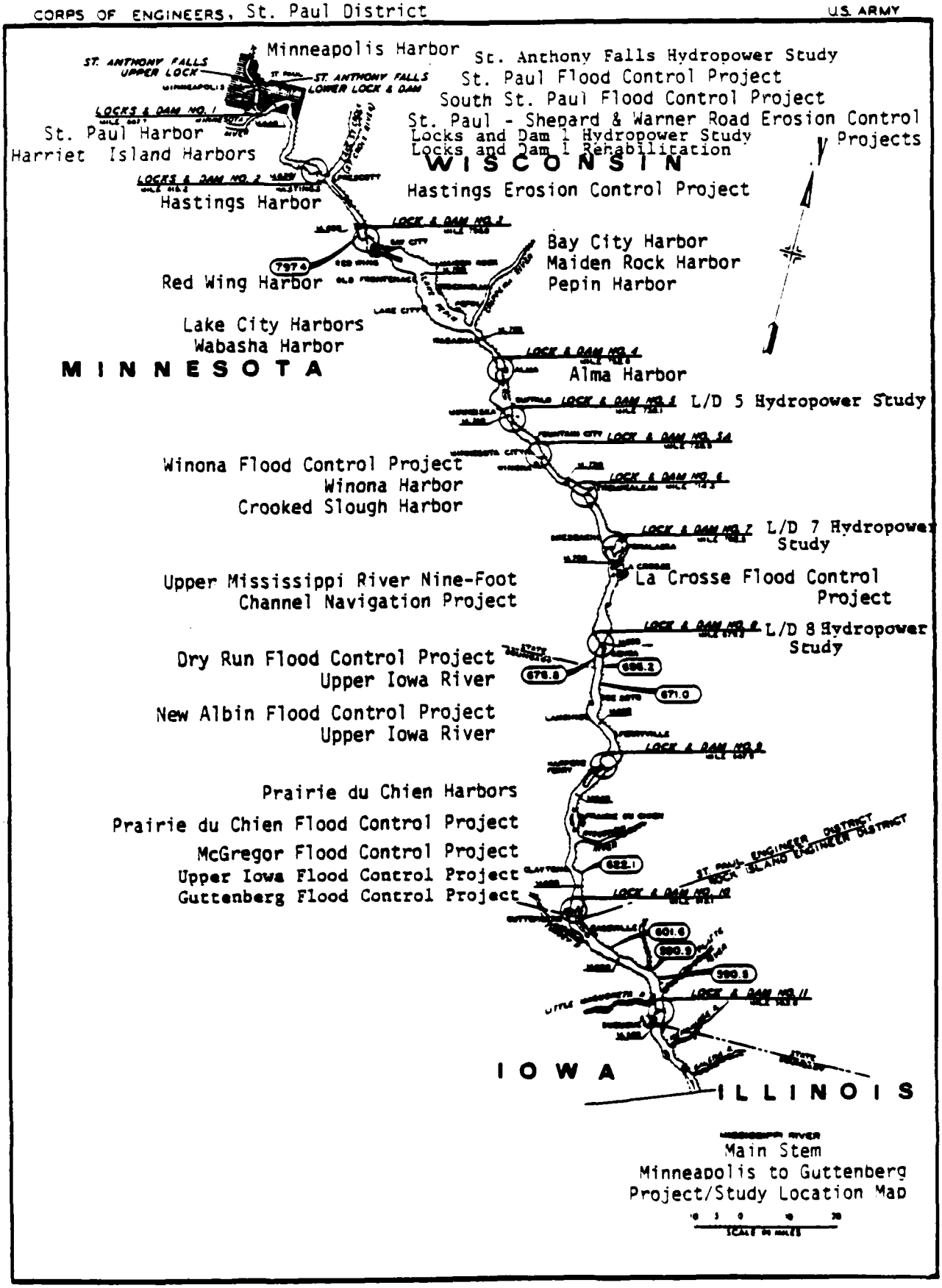
The Mississippi River, called the "Father of Waters" centuries ago, has played a prominent role in shaping our country. It first carried the canoes of the Indians and fur trappers, then the rafts and boats of the early homesteaders. Today, with its system of locks and dams, the Mississippi River is a major carrier of goods of commerce and industry for the central part of our Nation. Its most vital role in the domestic transportation system is the long distance movement of bulk commodities, especially the grain of the Upper Midwest. More than 700 shipping terminals are located along the Mississippi River and its tributaries. The number of commercial tows and the volume of tonnage have increased dramatically since the present navigation system became operational in 1940. In 1984, lock and dam 10 at Guttenberg, Iowa, passed about 2,000 commercial tows carrying about 19 million tons.

From the headwaters at Lake Itasca in north central Minnesota to lock and dam 10, Guttenberg, Iowa, the Mississippi River winds some 750 miles. In the last 243 miles, from Minneapolis to Guttenberg, the river is regulated by a series of 13 navigation locks and dams. Throughout its length the Mississippi River and its valley are known for their striking beauty. An incredible variety of fish and wildlife is found in its woodlands, islands, marshes, natural lakes, and streams. The Upper Mississippi River is a quality fishery resource, and fishing is excellent at many locations. Spectacular migration of birds is noted in the spring and fall. Furbearers and other mammals, plus about 40 smaller non-game species, are abundant.

Because of the slack pools created by the locks and dams, this waterway is a rich "natural" resource. The bald eagle, our national symbol, is found in large numbers along the Mississippi River, especially in the reach from Wabasha through Guttenberg. The Upper Mississippi River Wildlife and Fish Refuge covers most of the prime floodplain habitat from the outlet of Lake Pepin near Wabasha, Minnesota, to lock and dam 10 at Guttenberg.

The river and its resources offer splendid potential for public recreation. Each year millions visit the river to observe wildlife, to fish or hunt, to enjoy the pleasures of picnicking and boating, or simply to relax in the beauty and serenity of the environment.

The main stem of the Mississippi River as covered in this section extends from the head of navigation at river mile 858 in the Upper St. Anthony Falls pool in Minneapolis to lock and dam 10 at river mile 615 at Guttenberg. The major cities along the main stem of the river include the Minneapolis-St. Paul, Minnesota, metropolitan area at the head of navigation, and Winona, Minnesota, and La Crosse, Wisconsin, about 150 miles downstream. In this reach, four Federal purposes must be considered and balanced in the management of the river -- navigation, fish and wildlife, recreation, and hydropower. In addition, flood damage reduction measures are being pursued for the floodprone riverside communities.


Minneapolis Harbor
St. Anthony Falls Hydropower Study
St. Paul Flood Control Project
South St. Paul Flood Control Project
St. Paul - Shepard & Warner Road Erosion Control Projects
Locks and Dam 1 Hydropower Study
Locks and Dam 1 Rehabilitation
St. Paul Harbor
Harriet Island Harbors
WISCONSIN
Hastings Harbor
Hastings Erosion Control Project
Bay City Harbor
Maiden Rock Harbor
Pepin Harbor
Red Wing Harbor
Lake City Harbors
Wabasha Harbor
MINNESOTA
Alma Harbor
L/D 5 Hydropower Study
Winona Flood Control Project
Winona Harbor
Crooked Slough Harbor
L/D 7 Hydropower Study
Upper Mississippi River Nine-Foot Channel Navigation Project
La Crosse Flood Control Project
L/D 8 Hydropower Study
Dry Run Flood Control Project
Upper Iowa River
New Albin Flood Control Project
Upper Iowa River
Prairie du Chien Harbors
Prairie du Chien Flood Control Project
McGregor Flood Control Project
Upper Iowa Flood Control Project
Guttenberg Flood Control Project
IOWA
ILLINOIS
Main Stem
Minneapolis to Guttenberg
Project/Study Location Map

The construction of the navigation locks and dams in the 1940's and the subsequent maintenance of the 9-foot navigation channel project changed the character of the river and its floodplain. A series of flat-water pools was created by the locks and dams, replacing the broad expanse of floodplain forests and pasture land with large open-water pools and large marsh areas interspersed with islands and pockets of the floodplain forest. While the change was significant, the natural values of the Mississippi River floodplain are still extremely high. The co-existence of the Upper Mississippi Wildlife and Fish Refuge and the 9-foot channel navigation project in the same reach of the river attest to this value. The high natural values of the marshes and lakes have diminished somewhat in recent years as the backwater areas and side channels have experienced sedimentation problems. This reduction in ecological values stimulated the formation of the Great River Environmental Action Team (GREAT) in 1974. GREAT evaluated the operation and maintenance of the 9-foot channel project and the multiple use needs of the river and identified methods to improve the ecological values and to assure compatible multiple uses of the river. Many of the GREAT recommendations are being implemented through the operation and maintenance activities of the 9-foot channel project as well as the Upper Mississippi River System Environmental Management program (EMP). The EMP also is implementing other projects to improve recreation, environmental, and economic resources along the river. The EMP was authorized in the 1985 Supplemental Appropriations Act (Public Law 99-88) in conjunction with the Lock and Dam 26 project.

The design of the spillways of the locks and dams was based on a relatively short period of record preceding the 1930's, and the record flood of the 1880's was used as the spillway design flood. Thus, all of the structures are underdesigned to withstand a standard project flood. The climatic variation since the 1930's has resulted in increased base flows during the last 40 years as compared to the preceding 40 years.

The climate greatly influences the use of the river. For several months each year, the river is ice-covered. Most use of the river occurs during the ice-free period, which is generally from April to November. The commercial navigation season for the upper river starts when the first tow can break through the ice of Lake Pepin, usually in March or April. The season closes in November or December as the ice formation threatens to trap the tows in ice for the winter. Summer recreational boating use of the river is high, with over 3 million boating occasions annually. Total water-oriented recreational use of the river is estimated at about 5 million visitor-days annually. Recreational use of the river is important to the economy of the communities along the river.

In the Minneapolis-St. Paul metropolitan area, the rivers have been "rediscovered" as a valuable aesthetic, historic, and economic resource. St. Paul and Minneapolis are planning joint development of the port capabilities along the river.

Waterfront development of about $1 billion is proposed for Minneapolis. This development has been attracted by the historic and aesthetic appeal of

the river and St. Anthony Falls. Tremendous economic impact will result from replacing an old blighted area with revenue producing property. Also, in St. Paul, the St. Paul Riverfront Commission is reviewing plans to develop a portion of the Mississippi waterfront.

The Metropolitan Area River Corridors Study Committee was authorized by Public Law 96-607, Title 9, to make recommendations to optimize the recreational, fish and wildlife, nistoric, natural, scientific, scenic, and cultural values of the Mississippi, Minnesota, and St. Croix River corridors. The findings of the committee were reported to Congress and the President in January 1986. In August 1986, draft legislation was introduced to designate the 80-mile reach of the Mississippi River through the Minneapolis-St. Paul metropolitan area as the "Mississippi National River and Recreation Area."

2. **Status of Corps Work**

The 9-foot navigation channel project along the Mississippi River from Guttenberg, Iowa, through Minneapolis, Minnesota, is the principal focus of Corps activities along the Mississippi River main stem. Rehabilitation of the locks at lock and dam 1, completed in 1983, marks the beginning of a period of major structural rehabilitation of the navigation project which has now been functioning for about half a century. The rehabilitation of Locks and Dam 2 is currently underway. Channel maintenance activities to keep the navigation channel open include reducing dredging requirements through the use of channel control structures and handling dredged material in accordance with the guidelines of the GREAT reports which were developed through extensive interagency coordination and analysis. Continued implementation of the GREAT recommended activities will be a major element of future channel maintenance.

Navigation safety-related improvements are being evaluated at the approach to Locks and Dam 3 and at Wilds Bend in Pool 5A. These studies are being conducted to reduce the incidence of commercial navigation incidents and accidents at these locations.

The Upper Mississippi River Environmental Management Program (EMP) was authorized by the Water Resource Development Act of 1986. Its goal is to balance the management of the river in recognition of its many uses and values. The main components of EMP are habitat rehabilitation and enhancement projects (for example, dredging of silted-in backwaters) and a long-term resource monitoring program.

The Winona flood control levee project is completed. The project will provide a high level of protection for one of the major population centers along the main stem in this reach of the river.

The Prairie du Chien flood damage reduction project has resulted in successful removal of the majority of residences from the floodprone areas of the city.

The local flood protection projects at St. Paul and South St. Paul, Minnesota, and Guttenberg, Decorah, and Upper Iowa River outlet, Iowa, are complete and functioning as designed. The St. Paul project was reevaluated and a higher level of protection was found feasible. This project was authorized for construction by the 1986 Water Resources Development Act. Studies at La Crosse and Cochrane, Wisconsin, Gilmore Creek, Minnesota, and Lansing, Iowa, are listed as future needs.

Emergency levees have been constructed at South St. Paul, Newport, Inver Grove Heights, La Crescent, Lake City, and Wabasha, Minnesota, and at La Crosse, Wisconsin, and Marquette, Guttenberg, McGregor, Lansing, and Clayton, Iowa. Most of the levees were constructed during Operation Foresight just prior to the 1969 flood. Since construction, portions of some of these levees have been removed and/or modified so that protection is provided. A condition survey is underway to assess the current condition and relative risk to protected areas of these levees.

An aquatic plant control program is being initiated in the States of Minnesota and Wisconsin to control and progressively eradicate nuisance aquatic plant growth of economic significance. Although no specific sites have been considered along the Mississippi River main stem, potential areas likely exist.

There are currently 10 small-boat harbors on the river to meet recreational boating needs. The small-boat harbor at Lake City, Minnesota, has been expanded and additional harbors are being considered at six other locations.

Riverbank erosion projects have been completed at Hastings, Minnesota, and at Warner Road and Shepard Road in St. Paul.

Emergency water planning has been initiated in the State of Minnesota. This effort will help to focus local, State, and Federal attention on the potential needs of Minnesota communities and industries in times of major natural and national defense emergencies.

3. Future Corps Work

The following locations or communities need Corps assistance in the future. They are listed by category, priority, and estimated cost.

Project/ Location	Needs	Time Frame	Function and Benefit Category(1)	Relative Priority	Estimated Cost (2) ($ millions)
Functional Area:	Flood Control				
St. Paul, MN	Design and construct upgrade of existing flood control project.	1989 to 2000	1A	High	8.7
La Crosse, WI	Design and construct levee project along Mississippi River.	1989 to 2000	1A	High	29.6
Gilmore Creek, MN	Design and construct a flood control project.	1986 to 1990	1A	High	1.0
Cochrane, WI	Design and construct a flood control project.	1986 to 1990	1A	High	1.0
Lansing, IA	Design and construct a flood control project.	1986 to 1990	1A	High	0.5
Functional Area:	Water Supply/Water Quality				
Upper Mississippi River, Minneapolis to Guttenberg	Study, design, and construct measures to improve multi-use of the Upper Mississippi River through implementation of the Mississippi River System Environmental Management Program.	1986 to 2000	2A	High	50
State of Minnesota	Emergency Water Inventory and Planning for communities throughout the State of Minnesota.	1986 to 1990	2C	High	0.2

Project/ Location	Needs	Time Frame	Function and Benefit Category(1)	Relative Priority	Estimated Cost(2) ($ millions)
Functional Area:	Commercial Navigation				
Locks and Dams, Mississippi River from Minneapolis to Guttenberg	Major rehabilitation of ten locks and dams along 9-foot navigation channel project starting with locks and dams 2, 3, and 10.	1986 to 2000	3A	Hign	50-200
Locks and Dams, Mississippi River from Minneapolis to Guttenberg	New dredged material placement sites and channel control measures are being incorporated into the 9-foot navigation channel maintenance program as recommended by the GREAT study and the Channel Maintenance Forum.	1986 to 1990	3A	High	10-15
Wilds Bend Pool 5A	Navigation safety through Pool 5A.	1986 to 1995	3A	Medium	8
Lock and Dam 3	Navigation safety improvements at approach to Lock 3 to reduce hazards to commercial navigation.	1986 to 1995	3C	High	6
Functional Area:	Hydropower				
Mississippi River, Minneapolis to Guttenberg	Study, design and construct hydropower facilities at three of the navigation dams along the river. This work may be accomplished by private interests.	1986 to 1995	4A	Low	50

Project/ Location	Needs	Time Frame	Function and Benefit Category(1)	Relative Priority	Estimated Cost(2) ($ millions)
Functional Area:	Recreation/Fish & Wildlife				
Mississippi River, Minneapolis to Guttenberg	Study, design, and construct measures to improve multi-use of Mississippi River through implementation of the Upper Mississippi River System Environmental Management Program.	1986 to 2000	6C	High	50
Mississippi River, Minneapolis to Guttenberg	Study, design, and construct small-boat harbors at Pepin, WI; Guttenberg, IA; and Prairie Island, Minneiska, Red Wing, and Wabasha, MN.	1986 to 1990	6C	Low	1-3
Harriet Island Harbor, St. Paul	Complete design and construct recreational boat harbor facilities at the upper end of Harriet Island.	1989 to 2000	6C	Low	0.8
Mississippi River Basin	Control and progressively eradicate nuisance aquatic plant growth in basin lakes and waterways.	1986 to 2000	6C	Low	3

(1) Function is categorized as:

1. Flood Damage Reduction
2. Municipal - Industrial Water Supply
3. Commercial Navigation
4. Hydropower
5. Beach Erosion Control
6. Recreation

Benefits are categorized as:

A. Benefit-cost ratio (BCR) expected to be greater than 1.0 at the current interest rate, considering benefits only from categories 1-4.
B. BCR expected to be greater than 1.0 at the current interest rate, as long as some benefits are from categories 1-4.
C. All other studies and projects.

(2) Costs were estimated using October 1986 price levels. They include Federal and non-Federal construction costs and are approximate.

4. Summary

The 9-foot navigation channel was the principal focus of past work on the Mississippi River main stem and will continue to be the focus of work in the future. Major rehabilitation of the locks and dams from lock and dam 2 through lock and dam 10 will be the largest single program (now identified) to be accomplished in the next 25 years. This renabilitation will be essential to properly accommodate the commercial and recreational traffic using the river. The commercial tonnage shipped through lock and dam 10 is expected to reach 40 million tons in the next 25 years. The recreational boating on the river is expected to increase to over 4 million occasions annually in the same period. Continued maintenance of the navigation channel in accordance with the GREAT recommendations will be a high priority over the next 5 years, and thereafter channel work will be conducted in compliance with those recommendations. Implementation of the Upper Mississippi River Environmental Management Program will be a focal point for the States and communities along the river over the next decade.

Although execution of flood control projects will be at a relatively low level, the potential for flood damage in the areas will continue to be reduced through project implementation.

It is likely that at some time in the next 50 years the climate related trends will shift from the current "wet" cycle to a "dry" cycle. When this occurs, the water needs of the area must be evaluated to develop innovative solutions to prevent and/or minimize major shortages. This has been partially initiated through the emergency water planning being conducted for the State of Minnesota.

MISSISSIPPI RIVER HEADWATERS
(Including St. Croix Basin)

1. Description

The Upper Mississippi River Headwaters basin is defined as that area in Minnesota and Wisconsin which involves the Mississippi River above mile 858.0 in the Minneapolis-St. Paul metropolitan area, and the St. Croix River basin. Mile 858.0 is upstream of the Upper St. Anthony Falls project, located upstream of 41st Avenue North in Minneapolis, on the Mississippi River. The Mississippi River and its floodplain below mile 858.0 are included in the Upper Mississippi River Main Stem section of the report. The Mississippi River Headwaters area also excludes the Minnesota River basin which enters the Mississippi River at St. Paul. The boundaries conform to plan area number 1 in tne 1972 Upper Mississippi River Comprehensive Basin Study (see the attached map).

The drainage area of this basin is 28,000 square miles. The area is 14.9 percent of the Upper Mississippi River basin and has 1,791 square miles of natural water area. The area drains the Mississippi River Headwaters in Minnesota and the 7,650-square mile St. Croix River basin in Minnesota and Wisconsin. Approximately 4,300 square miles of the St. Croix River basin are in Wisconsin.

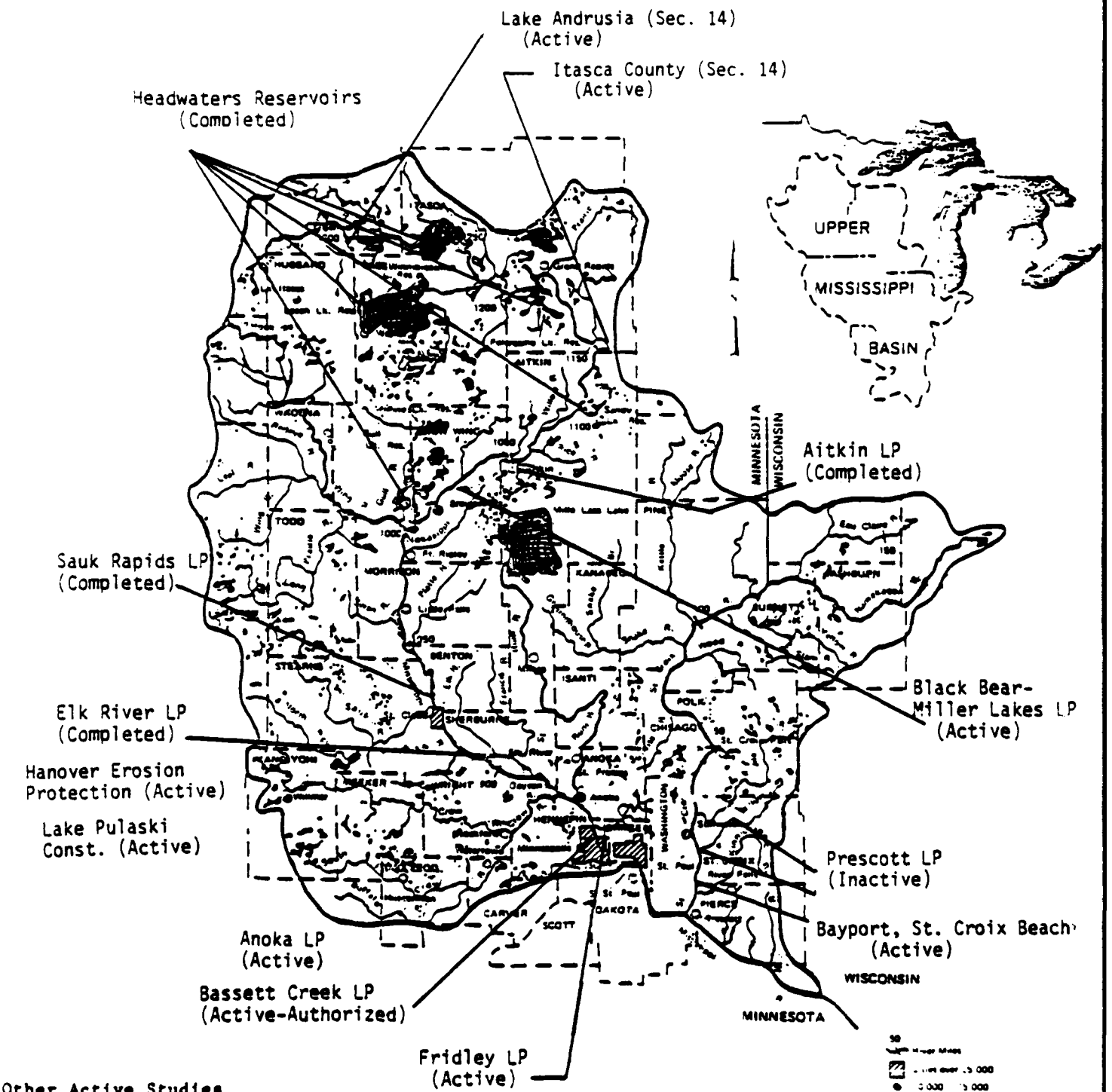
The basin is glaciated, and glacial deposits range from a few feet to several hundred feet thick. The land surface is irregular with low hills and ridges. Local relief varies from a few feet to 40 to 50 feet.

The basin contains 250,000 acres of water and 1,983,000 acres of land that can be used for recreation as well as more than 7 million acres of forest. The area is one of the few remaining places in the United States with moose, timber wolf, black bear, martin, fisher, snowshoe hare, spruce partridge, and osprey.

The annual median runoff is about 0.28 cfs per square mile of drainage area, and the minimum potential groundwater supply is 3,230 mgd. Mean daily maximum temperature is 80°F in July for the northern part of the area, and mean daily minimum temperature is -6°F in January.

Population of the area in 1980 was 2.7 million, of which 4.3 percent was farm population. The Minneapolis-St. Paul Standard Metropolitan Statistical Area (SMSA) and St. Cloud, Minnesota, 65 miles upstream, are the only two metropolitan areas with over 30,000 population. There has been a spreading of the population as more residents live in smaller urban centers. In 1970, Minneapolis-St. Paul contained 80 percent of urban residents. This dropped to only 66 percent in the 1980 census. Per capita income for the basin in 1979 was $7,592 and is expected to rise to $10,335 by 2020.

A rising groundwater table and rising lake levels have occurred in portions of the basin in the last 12 years. The lakes in Stearns and Wright



MISSISSIPPI HEADWATERS

Other Active Studies
[By County (MN)]

Lk. Charlotte	- Wright
Helene Lake	- Sherburne
Carnelian Lk.	- Stearns
Sandy Lake	- Sherburne
Beaver Lake	- Stearns
Lake Diann	- Sherburne
Briggs Lake	- Sherburne
Pelican Lake	- Wright
Cantlin Lake	- Sherburne
Shell Lake	- Washburn (WI)

LP = Local Protection

March 1987

Counties, Chisago Chain of Lakes, Marine Lake, and Carnelian Lake are all representative of this phenomenon which apparently is related to the climatological cycle that we are in at this time. There are more than 40 lakes with this condition. These higher lake levels adversely affect the developments that have occurred around the landlocked lakes, but constitute an increased water bank which eventually contributes to the Mississippi River main stem runoff.

The seven county metropolitan area has "rediscovered" the rivers as a vital economic attribute for their aesthetic and historic values, commercial uses, and recreational aspects. Minneapolis and St. Paul are planning joint development of the port capabilities. In Minneapolis, plans and construction are underway for an $800 million development along the Mississippi River waterfront. This development has been attracted to the area by the historic and aesthetic values of the river and St. Anthony Falls. St. Paul has organized a downtown riverfront commission. Communities along the St. Croix River have extensively redeveloped their downtown areas, incorporating preservation and enhancement of historic buildings for current commercial purposes. Thousands of visitors tour these picturesque towns and attend their festivals.

The Metropolitan Area River Corridors Study Committee was authorized by Public Law 96-607, Title 9, to make recommendations to optimize the recreational, fish and wildlife, historic, natural, scientific, scenic, and cultural values of the Mississippi, Minnesota, and St. Croix River corridors. The Committee reported its findings to Congress and the President in January 1986. Draft legislation was introduced in August 1986 to designate the 80-mile reach of the Mississippi River through the Twin Cities Metropolitan area as the "Mississippi National River and Recreation Area." This legislation provides for a comprehensive plan controlling development in this corridor in order to preserve natural resources, recreational values, and the balance of uses. The Department of the Interior would be given review and approval authority over Corps permit and other water resources missions, including navigation.

2. Status Of Corps Work

Minnesota

The Corps constructed six water control dams in the Mississippi River Headwaters area between 1881 and 1913, primarily to benefit river navigation, with incidental benefits for logging. The dams control Winnibigoshish, Leech, Pokegama, Sandy, Pine, and Gull Lakes. The need for water from these reservoirs was greatly reduced after completion of the 9-foot navigation channel below Minneapolis in the 1930's. The Corps also constructed 28 perimeter dikes around four of the six headwaters lakes in the early 1900's to prevent impounded water from seeking alternate overflow outlets.

The Corps carried out a number of channel improvements on the Mississippi River between Winnibigoshish and Pokegama Lakes and between Leech and

Pokegama Lakes before 1926. In 1957, the Corps constructed a project that diverted one-half of the first 12,000 cfs of Mississippi River flow around the city of Aitkin, Minnesota. The Aitkin diversion channel provides agricultural flood protection. The design channel capacity was assigned an exceedence frequency of 12 years (8.3 percent) for annual flooding when designed in 1952.

A feasibility study was completed in September 1982 for the Mississippi River above St. Paul. Ten problems related to the six Mississippi River Headwaters reservoirs were addressed in the study; the major problem concerned suggested changes in reservoir operation. Four of the problems were recommended for further study under the Small Projects Program or other authorities. Under the Dam Safety Program the Corps completed a reconnaissance report for Winnibigoshish Dam in September 1986. No dam safety work is required at Winnibigoshish Dam. Five more reports will be completed for the remaining Headwater Reservoirs in 1987 and 1988.

There are nineteen active Section 205, Section 14, or feasibility studies for flood control in the Minnesota portion of the basin. A Corps feasibility study for flood damage reduction at Stillwater, Minnesota, has been completed. No structural solution was found economically feasible, but a flood preparedness handbook was prepared.

Residential areas in the upper portion of Bassett Creek and industrial and commercial lands in the lower watershed, involving downtown Minneapolis, Minnesota, are included in a local flood protection project. This project was authorized by the 1976 Water Resources Development Act and is currently in the construction stage.

Thirteen communities or entities in the Minnesota portion of the drainage area have emergency levees that were constructed with the assistance of the Corps of Engineers. Most of these levees were constructed in 1969 during "Operation Foresight" when the Corps provided pre-flood assistance to scores of communities. Some emergency levees have been modified since 1969 in response to flood threats. The communities or entities with emergency levees are as follows:

City	County
Hutchinson	McLeod
Watertown	Carver
Delano	Wright
Rockford	Wright
Fridley	Anoka
Elk River	Wright
Aitkin	Aitkin
Stillwater	Washington
Lake St. Croix Beach	Washington
St. Marys Point	Washington
Afton	Washington
Bradford Township	Isanti
Glencoe	McLeod

Levee condition surveys were conducted in the community of Aitkin, Minnesota, in the Upper Mississippi River basin in 1986. These surveys were conducted on the 1969 flood control levees constructed with the aid of Federal funds under Public Law 84-99. The surveys were conducted to inform the affected community of risks associated with these levees with recommendations on what should be done if these levees are retained by the city.

The aquatic plant control program will provide for control and progressive eradication of nuisance aquatic plant growth of economic significance in lakes and waterways in the States of Minnesota and Wisconsin. The Federal Government will work cooperatively with State and local governments to address and solve problems of mutual interest involving nuisance aquatic plant growth. The program is in the early stage of development and has potential for inclusion of many lakes and waterways in the two States.

Wisconsin

There is one active Section 205 project in the Wisconsin portion of the basin (Shell Lake). A Corps feasibility study for flood damage reduction at New Richmond, Wisconsin, was completed but no plan was acceptable to the city and no Federal action has been recommended. A small-boat harbor project at Hudson, Wisconsin, was deauthorized in 1986, and a levee project at Prescott, Wisconsin, is currently classified as inactive.

3. **Future Corps Work**

The locations or communities included in the following tabulation need Corps assistance in the future. The table shows the category, priority, and estimated cost of the work at each location. With a possible annual return of 1.5 times the investment for flood protection, these flood control projects could provide approximately $12 million in annual benefits.

Project/ Location	Needs	Time Frame	Function and Benefit Category(1)	Relative Priority	Estimated Cost(2) ($ millions)
Functional Area: Flood Control					
Bassett Creek, Minneapolis, MN	Construct levee/ channel/tunnel flood control project.	1986 to 1991	1A	High	33.4
Black Bear-Miller Lakes, MN	Construct flood barrier (levee and control structure).	1986	1A	Hign	0.3

Project/ Location	Needs	Time Frame	Function and Benefit Category(1)	Relative Priority	Estimated Cost(2) ($ millions)
Functional Area:	Flood Control (Continued)				
Anoka, MN	Study, design, and construct flood damage reduction project (levee).	1987 to 1990	1A	Medium	3.0
Bayport, MN	Study, design, and construct flood damage reduction project (levee/road raise).	1985 to 1995	1A	Medium	4.0
St. Croix Beach, MN	Study, design, and construct flood damage reduction project (levee).	1985 to 1995	1A	Medium	2.5
Headwaters Lakes, MN	Dam Safety Reconnaissance Reports, study, design, and repair/construct.	1985 to 1988	3A	Medium	6.5
Charlotte, Helene, Sandy, Beaver, Diann, Briggs, Pelican, and Cantlin Lakes in MN and Shell Lake, WI	Study, design, and construct lake stabilization projects.	1986 to 1990	1A	High	3.0
Headwaters Lakes, MN	Flood emergency action plans for five remaining headwater sites.	1985 to 1987	N/A	Medium	0.13
Small Flood Control Projects Regionwide	Study, design, and construct plans of improvement in flood damage in rural and urban areas.	1986 to 1990	1A	High	0.5/ year

Project/ Location	Needs	Time Frame	Function and Benefit Category(1)	Relative Priority	Estimated Cost(2) ($ millions)
Functional Area:	Water Supply/Water Quality				
Mississippi River Basin	Control and progressively eradicate nuisance aquatic plant growth in basin lakes and waterways.	Continuous	6C	Low	0.3/ year
State of Minnesota	Federal emergency water inventory and planning under EO 11490.	1987	2C	High	0.2
Functional Area:	Other				
Section 14 studies region-wide, including Lake Andrusia (Beltrami Co.) and Itasca Co.	Provide for development of plans for the construction of bank protection projects that will protect essential public works.	Continuous	1A	High	0.4/ year

(1) Function is categorized as:

1. Flood Damage Reduction
2. Municipal - Industrial Water Supply
3. Commercial Navigation
4. Hydropower
5. Beach Erosion Control
6. Recreation

Benefits are categorized as:

A. Benefit-cost ratio (BCR) expected to be greater than 1.0 at the current interest rate, considering benefits only from categories 1-4.
B. BCR expected to be greater than 1.0 at the current interest rate, as long as some benefits are from categories 1-4.
C. All other studies and projects.

(2) Costs were estimated using October 1986 price levels. They include Federal and non-Federal construction costs and are approximate.

Work to be done or future needs have not been identified in the following areas.

Functional Area: Commercial Navigation

Functional Area: Hydropower

Functional Area: Recreation/Beach Erosion

4. Summary

The Mississippi River Headwaters area is environmentally sensitive, and the general feeling of area residents is one of preservation and protection of their existing environment. The area has its share of flood problems which are confined to the smaller communities and agricultural areas. These flood problems are being addressed under the Corps Small Projects Program or the National Flood Insurance Program, for the most part.

A September 1982 Mississippi River Headwaters study involved primarily the reservoir controlled 4,500 square miles of watershed drainage area that is a part of the 6,100-square-mile drainage area above Aitkin, Minnesota. However, a small flood control project for Black Bear-Miller Lakes in Crow Wing County, downstream of Aitkin, was recommended for further study under the Small Projects Program and is now under construction. The effect of regulating the six headwaters lakes was also evaluated for the Minneapolis-St. Paul SMSA (drainage area of 19,400 square miles).

High lake levels on more than 40 lakes in central Minnesota and northeastern Wisconsin are presenting significant flood concerns to existing developments. Immediate attention is being given to solving the problems quickly. Construction is underway at Lake Pulaski, Minnesota, and many more studies are ongoing under the Section 205 program.

Recreation is important to the economy of the Mississippi River Headwaters area, attracting millions of visitors to the area each year. At least one-fourth of the demand for outdoor recreation facilities in the region is for water related activities. The Corps-operated Headwaters Lakes of Winnibigoshish, Leech, Pokegama, Sandy, Pine River, and Gull experience over 8 million days of recreation use annually.

The Mississippi River Headwaters area has an abundant supply of natural lakes and rivers, including the Wild and Scenic St. Croix River system. More than 7 million acres of forest supports a great variety of wildlife. White-tailed deer and waterfowl provide excellent hunting, and the fishing opportunities attract many.

The enhancement and maintenance of recreation facilities on Corps owned land will further strengthen the economic viability of the upper headwaters area. The Headwaters Reservoirs are one of the most frequently cited destinations of transient recreationists in the State.

The major work to be accomplished seems to be finding solutions to the flood problems of individual communities identified under the National Flood Insurance Program and the Corps basin studies. The annual benefits from providing flood protection to the 14 areas previously identified could equal $12 million annually. The flood control projects are needed to offset the damage and suffering caused by periodic inundation of residential and commercial properties in the affected areas. Other major items to be addressed are water supply and water quality problems of the Minneapolis-St. Paul SMSA which could develop in the future and the high water levels in troubled lake areas.

The Bassett Creek project involving downtown Minneapolis and outlying residential areas is expected to be under construction in fiscal years 1987 and 1988. This project was a new construction start for the St. Paul District in fiscal year 1985 and is one of only 44 projects in the Nation that have a signed Local Cooperation Agreement with the local sponsor that meets current administration cost-sharing guidelines (Agreement was signed June 28, 1986).

STATEWIDE PROGRAMS
EMERGENCY WATER SUPPLY PLANNING

1. **Description**

Emergency water planning is being accomplished by the Corps of Engineers on a State-by-State basis. Executive Order 11490 is the current basis for the Federal Emergency Resource Management Program and assigns Federal planning responsibility to the Corps of Engineers for the Nation's water supply production. The Corps has developed a program to inventory water supply information in six major areas:

- Water demand and source.
- Water availability agreements (State law, etc.).
- Existing water supply emergency response network.
- Existing water supply preparedness planning.
- Analysis of water utility vulnerability to hazards.
- Demand for support resources such as chemicals and trained people.

The inventoried information will be made available to State emergency managers to harden their preparedness and response to water supply emergencies. Federal involvement in resolving a water supply emergency would only occur if the President or Congress determined that it exceeded the capabilities of the involved States. Water allocation would remain the responsibility of each State, except possibly in extreme national emergency conditions. However, the support resources needed to prepare and deliver the water are not controlled by an existing emergency allocation system and have historically been subject to demands for competing uses. Thus, the Federal Government is developing "standby" plans for emergency allocation of support resources during a widespread natural disaster or national security event such as mobilization for war.

2. **Status of Corps Work**

The Minnesota emergency water planning inventory began in October 1985 and will be completed by September 1987.

The Wisconsin inventory is scheduled to begin October 1986 and be completed September 1988.

Depending on the nationwide results of the State-by-State inventories, additional work may be programmed by the Office of the Chief of Engineers for the early 1990's.

END

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